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With METALLURGICAL SUPPLEMENT.

The Engineer.

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PUBLIC NOTICES.

Civil Service Commission.

FORTHCOMING EXAMINATION.

PROBATIONARY INSPECTORS (MALE) in the Engineering Department of the Post Office (17-23, with extension for service in H.M. Forces).

Regulations and particulars, together with the forms on which applications must be made, will be sent in response to requests (preferably by postcard), addressed to the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1, GIVING THE TITLE OF THE SITUATION. The latest date for the receipt of application forms is 22nd October, 1931. 7377

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Beeston Urban District Council.

TO MANUFACTURERS OF ELECTRICAL PUMPING MACHINERY.

The above Council is prepared to receive TENDERS from Pumping Machinery Manufacturers for the SUPPLY, DELIVERY, and ERECTION at the Council's Sewage Disposal Works, Beeston, Notts., of No. 8 Electrically Driven VERTICAL-SPINDLE CENTRIFUGAL PUMPS, &c., and all appurtenant works connected therewith.

As the works, the subject of the contract, are works in respect of which a grant is to be given by the Unemployment Grants Committee, expressly to relieve unemployment, it is a condition of the grant that all the contracts for or incidental to the work shall be placed in this country and all goods and materials supplied under the contract shall be of United Kingdom origin and manufacture.

Specification and plan may be obtained from the Council's Consulting Engineers, Messrs. W. H. Radford and Son, Civil Engineers, Albion Chambers, King-street, Nottingham, on deposit of Three Guineas (cheque), which will be returned on receipt of a bona fide Tender and the return of the specification and plan. Only manufacturers of pumping machinery need apply.

The lowest or any Tender will not necessarily be accepted.

Sealed Tenders, endorsed "Pumping Machinery," to be delivered to me at my office, as under, not later than the first post on Monday, 19th October, 1931.

By Order,
C. H. WRAGG,
Clerk to the Urban District Council.

Council Offices,
Beeston, Notts.,
September 25th, 1931. 7556

Borough of Chepping Wycombe.

WATERWORKS.

CABLES FOR ELECTRICAL RECORDERS.

The Corporation of the above Borough invites TENDERS from British Manufacturers for the SUPPLY and DELIVERY at High Wycombe of about 9400 Yards of LEAD-COVERED, FOUR-CORE CABLE.

Copies of the specification and form of Tender may be obtained from the office of Mr. W. Vaux Graham, M. Inst. C.E., 5, Queen Anne's-gate, Westminster, S.W. 1, upon depositing the sum of One Pound, which will be returned upon receipt of a bona fide Tender.

Sealed Tenders, marked "Cables for Electrical Recorders," must be received by Mr. Sydney Young, Waterworks Engineer and Manager, 71, Easton-street, High Wycombe, not later than the first post on Monday, October 5th, 1931.

The Corporation does not bind itself to accept the lowest or any Tender.

PHILIP B. BEECROFT,
Town Clerk.

Town Clerk's Office,
High Wycombe,
21st September, 1931. 7549

The Engineer

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PUBLIC NOTICES.

The Civil Engineers Appointments Board, 8, Princes-street, Westminster, S.W. 1, acting under annual licence from the London County Council, invites ENQUIRIES from EMPLOYERS SEEKING the SERVICES of PROFESSIONAL ENGINEERS, either as Assistants or in more responsible positions.

All those whose names are accepted for entry in the Board's Register for employment possess qualifications which have been attested by means of scientific examinations, practical training and experience. P1305

City and County of Bristol.

TO PUBLIC BATHS ENGINEERS.

SHIREHAMPTON BATHS.

The Baths Committee of the Corporation of Bristol invite TENDERS for the ENGINEERING WORKS, comprising the Supply and Fixing of Boiler Plant, Filtration and Treatment Plant, Steam Supplies, Hot and Cold Water Services and Low-pressure Steam Heating, for proposed new PUBLIC BATHS at Parkroad, Shirehampton, Bristol.

Copies of the general conditions, specification, drawings and form of Tender may be obtained at this office on or after the 24th September, 1931, on deposit of Two Guineas, which will be returned on receipt of a bona fide Tender.

Tenders must be made out on the forms provided and all blanks must be filled in, otherwise they will not be considered.

Sealed Tenders, enclosed in the envelope provided, must be delivered at the office of the Town Clerk not later than 10 a.m. on Monday, the 12th October, 1931.

In the event of any Tender being accepted the Corporation will require the contractor to provide approved security for the due performance of the contract in the sum of £500.

The contractor whose Tender is accepted will be required to comply with the regulations of the Unemployment Grants Committee, which are given in the bills of quantities, regarding the employment of labour on the works.

Preference will be given, where possible, to contractors who are on the King's National Roll.

The Corporation do not bind themselves to accept the lowest or any Tender.

JOSIAH GREEN,
Town Clerk.

The Council House, Bristol.
17th September, 1931. 7542

PUBLIC NOTICES.

The River Avon (Bristol) Catchment Board.

APPOINTMENT OF ENGINEER.

APPLICATIONS are INVITED from Civil Engineers with experience in Land Drainage for the POSITION of ENGINEER to the Board.

The gentleman appointed will be required to devote the whole of his time to the duties of the appointment. The salary will be at the rate of £500 per annum, and office and staff will be provided by the Board. At the discretion of the Board the salary may be increased by increments to £600 per annum. There will be an allowance for use of car for purposes of inspection, &c.

Applications, giving experience, qualifications, date of birth and present salary and accompanied by not more than three recent testimonials, must be forwarded to me on or before Wednesday, the 14th day of October, 1931. The envelope should be sealed and endorsed "Engineer."

Canvassing will be regarded as a disqualification.

FRANK M. HART,
Acting Clerk to the Board.

The Council House, Bristol. 7547

SITUATIONS OPEN.

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THE OWNERS of BRITISH PATENTS Nos. 279,486, 283,933, "Pumps;" and No. 301,249, "Water Ring Pump," are DESIROUS of ARRANGING by LICENCE or otherwise for the MANUFACTURE and DEVELOPMENT of the INVENTION in Great Britain.
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THE PROPRIETORS of BRITISH PATENT No. 260,196, relating to "A Process of Assembling Axle Constructions," are DESIROUS of ENTERING into ARRANGEMENTS with British Manufacturers with a view to the SALE or COMMERCIAL EXPLOITATION of the INVENTION protected by the said Patent.
Interested parties are invited to communicate with the undersigned for futher particulars:
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PATENTS.

THE PROPRIETOR of BRITISH PATENTS Nos. 248,075, dated November 27, 1924, relating to "Improvements in a Paper Cup Forming Machine with Stacking Attachment;" 246,602, dated November 13, 1924, relating to "Improvements in a Cup Blank Punching Machine;" and 241,400, dated November 13, 1924, relating to "Improvements in and relating to the Counting Mechanism of Machines for Forming Paper Cups and like Containers," DESIRES to ARRANGE by LICENCE or otherwise on reasonable terms to EXPLOIT the above patents and ensure their practical working in Great Britain.—Inquiries to B. SINGER, Steger Building, Chicago, Ill. 7515 H

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A Seven-Day Journal

Salesmanship.

AT the annual general meeting of the Incorporated Sales Managers' Association, when Sir Francis Goodenough was again elected President, the following resolution was adopted:—"The members of the Incorporated Sales Managers' Association in annual general meeting heartily welcome the final report of the Government Committee on Education for Salesmanship, and trust that its conclusions and recommendations will receive the early and thorough consideration of every business firm and of all the organisations of commerce and industry throughout the country. They especially commend consideration of the report to the Chambers of Commerce in Great Britain and Ireland, and extend to these Chambers an invitation to a conference upon the subject to be held at an early date. In particular, the Association endorses fully the opinion expressed by the Committee that:—'The country's prosperity depends immediately upon the effective sale of goods, and the standard of any country's marketing is determined by the men and women engaged upon it. Conditions in the world of commerce become more intensively competitive every year. Our progress, indeed our survival, as an industrial nation depends on the employment in the direction, management and operation of our commercial and industrial enterprise of first-class *personnel* soundly educated for the scientific as well as the vigorous conduct of business. . . . The question of securing improved *personnel* for the service of British trade at home and abroad is one of urgent importance.'"

The Gold Standard.

AT the time of writing, no signs of panic owing to the temporary departure from the gold standard are to be seen in British industries, and no reason for expecting them exists. Yet some good purpose may be served by the message just circulated by Sir Roland Nugent, Director of the F.B.I. "There is nothing," he writes, "in the decision to go off gold which need unduly alarm the public. Fundamentally, the position of the country is as sound as ever. It should be realised that there is no similarity between abandoning the gold standard as the result of an abnormal international situation, but with a balanced Budget, good stocks of raw materials and food, fully equipped industry, and large assets all over the world, and the immediate post-war position in countries, such as Germany, where inflation resulted from a complete exhaustion of all internal resources, the absence of foreign assets, and a hopelessly unbalanced Budget. In our present position, if every man keeps his head and carries on with his job, any readjustments there may be will come gradually, and in all human probability with so little inconvenience or loss to the ordinary individual that he will scarcely notice that anything has happened. All that is required is the general steadiness, common sense and unity which the country has always hitherto shown in difficult circumstances. There is even a definitely encouraging aspect in the events of the last few days in that they must have immensely increased the probability of concerted international action to remedy the world's troubles. Once again Great Britain has been given an opportunity to save herself by her exertions and the world by her example."

British Electric Railway Equipment for Hungary.

WHAT is described as the greatest piece of "door-to-door" transport work so far undertaken by a British Railway company is being arranged by the London and North-Eastern Railway and the Harwich-Zeebrugge Train Ferry companies. It will involve the through carriage of 1,382 tons of electrical equipment from Manchester to Budapest for the Hungarian State Railways, which are electrifying the main Hungarian line towards Vienna from Budapest to Komarom. As we reported in our issue of May 1st, an order for a large portion of the equipment was placed with the Metropolitan-Vickers Electrical Company, and it is part of this equipment which has given rise to this heavy transport job. All the motors and control gear for the locomotives and the switchgear and transformers for the sub-stations are being made at the Trafford Park works, whilst the mechanical parts and certain electrical parts of the locomotives are being produced in Hungary. It will be remembered that the system to be used is that devised by the late Dr. de Kando, and that it differs from all others in that standard 50-cycle A.C. is to be drawn at a pressure of 16,000 volts from a single overhead line. There will be no converting or frequency-changing sub-stations, and the fact that a large part of the work for this new and interesting scheme has come to this country indicates that great faith is placed in the ability of British electrical engineers. Not only has a British engineering company been entrusted with a large portion of this work, but the transport work involved will be carried out by a British railway company using its own wagons. The equipment to be despatched will include eight transformers, each weighing 26½ tons, sixteen switches each weighing 7½ tons, 330 tons of switchgear, and thirty-six locomotive motors each weighing 20 tons. Special well trolley wagons, having carrying capacities varying from 20 to 110 tons, are to be employed. The wagons will travel from Manchester to Harwich and will cross to Zeebrugge on the train ferry, and will then proceed straight to Budapest over the continental railways, a total distance of over 1200 miles.

A New Coal Research Laboratory.

ON Tuesday last, September 22nd, the new laboratory of the Lancashire and Yorkshire Coal Research Association at Park-street, Cheetham, Manchester, was formally opened. The work of the Association was begun in an informal way thirteen years ago, and in 1919 laboratory accommodation was provided at the Manchester College of Technology. The new laboratory was opened by Mr. Robert A. Burrows, vice-chairman of Manchester Collieries, Ltd., who was the founder of the laboratory. Dr. F. S. Sinnatt, who was the first consultant, was also present, in company with Professor J. S. Haldane, Mr. Eustace Mitton (the President of the Institution of Mining Engineers), and Mr. John McGurk (President of the Lancashire and Cheshire Miners' Federation), and other representatives of the coal industry. The new premises comprise a basement, a ground floor, and a first floor. In the basement provision has been made for the reception and treatment of bulk samples of coal. The ground floor is occupied by administrative offices and staff and the quarters of two mining investigators, who are working under the Safety in Mines Act; while the top floor is given over to laboratory accommodation. The staff has now grown from two assistants in 1919 to twenty-two, including seven assistants in the palæo-botanical section, which in 1920 was taken over from the Lomax Palæo-botanical Company, of Bolton, where this special work is still being carried out in enlarged premises. Several speakers bore testimony to the value of the laboratory work in advancing the scientific study of coal, in reducing the number of mining accidents, and in assisting generally the prosperity and welfare of the industry.

Compagnie Generale Transatlantique.

THE reorganisation of the Compagnie Générale Transatlantique, under the direction of Monsieur Germain-Martin, who was nominated by the French Government to carry out the scheme outlined in our Journal note of July 10th, is progressing rapidly. A new board of directors has been constituted, and two vice-presidents have been elected. These are Monsieur Dautry, the General Manager of the French State Railways, and Monsieur René Fould, the President of La Societe Anonyme des Chantiers et Ateliers de St. Nazaire, Penhöet, while Monsieur Henri Caugardel, a shipping expert, will be the general manager, and Monsieur Fabre the managing director of the Chargeurs Réunis. The efforts of the new board will be directed towards the introduction of economies, and the simplification of the commercial and the financial organisation of the company's affairs. The Government is to exercise control, and it has induced the company's two principal creditors to extend their credits, one for a further period of five years and the other for two years. A proposal has been made that a much larger Government subsidy should be granted. Hitherto, the French line has received about £32,000 yearly for its Havre-New York services, and £24,000 for its Central American services, in return for which the Government's mail was carried free. Under the proposed new subsidy the company would receive £240,000 for its New York services, in addition to a subsidy to cover the deficit on the Central American lines, while the transport of mail would be paid for. The Government also proposes to make the company an advance of £200,000 without interest.

Large Steel Castings for the New Cunard Liner.

ON Friday, September 18th, the works of the Darlington Forge, Ltd., were opened to visitors for the inspection of the large steel castings which the firm has produced for the new 73,000-ton Cunard liner, now under construction at John Brown's Clydebank yard. The castings include the stern frame, which has a length of over 80ft. and weighs close upon 190 tons, two brackets for the outer propeller shafts weighing 190 tons, and a rudder frame casting, which has a weight of about 134 tons. On Monday last the task of dismantling these castings and loading them on special trucks, making a train some 160 yards in length, was begun, in readiness for Sunday next, when they will be transported to the wharf of the Furness Shipbuilding Company, Ltd., of Haverton Hill-on-Tees, near Middlesbrough. Owing to the very large dimensions and great overhang of the castings, the entire railway track between Darlington and Haverton Hill will have to be made available on Sunday next for the transport of the castings. On Monday the castings will be put aboard a specially chartered steamer, which will deliver them at the builder's Clydebank yard. The work has occupied nearly a year, and is the most important work of its kind which the company has undertaken. It may be recalled that in addition to supplying similar castings for important liners recently added to British-owned fleets, the firm supplied steel castings for the "Mauretania," "Aquitania," and the "Olympic."

Trafford Park to Dagenham.

PARTICULARS are now available concerning the arrangements which have been made for removing the heavy machinery of the Ford Motor Company from that company's present works at Trafford Park, Manchester, to the new factory at Dagenham, Essex. The plan, which is now well advanced, provides for the removal by complete units of both machinery and staff. Each piece of machinery is numbered to correspond with the truck in which it will travel, and its position in the new works. Only two days are allowed from the beginning of dismantling each unit in Manchester to the completion of its erection at Dagenham, the intervening night being occupied in railway transit. Both the London, Midland and Scottish and London and North-Eastern railways have co-operated in the removal programme, and to date more than sixteen trainloads, each of fifty wagons, have been dealt with. Much heavy machinery has still to be removed before the household goods of staff members are transported. As each piece of machinery is set to work at Dagenham, the newly erected machine unit is taken over by a special staff of men for test by itself in a variety of ways. These tests are followed by various others in conjunction with the already erected machines, the testing work being continued as further new units are added. Some time must elapse before the completion of the transfer of men and machinery, and it is understood that for the present only the services of members of the firm's existing staff can be absorbed at the new Dagenham works.

Anti-Dazzle Devices.

AT the end of last week a number of motor car headlights were demonstrated on Midsummer Common at Cambridge before chief constables from all parts of the country and representatives of Scotland Yard and the Ministry of Transport. The demonstration was brought about by the desire to settle the question as to the best method of reducing dazzle. At present the Ministry of Transport favours dipping headlamps, or those that swivel and direct the beam on to the side of the road. Both these methods have the disadvantage that the range of the beam of light is reduced and, in consequence, the safe driving speed is lowered. A very large proportion of the devices demonstrated had as their object the retention of the range of the lights with, at the same time, a reduction in the glare. Glare, it was found, could be overcome, but, on the whole, it appeared that the most effective devices were also the most expensive. The ideal beam, apparently, is one that, while keeping low, throws a light for a distance of about 300ft. ahead of the car. Various methods were used at the demonstration. Frosted and mottled glass for diffusion, the use of shutters and shields to deflect the beam, and means for reducing or altering the power of the reflector of the lamp were all in evidence. Many alternatives to dipping, obviously exist, and some of the devices shown are likely to prove useful in the future when they have been perfected.

Oil from Coal.

FURTHER to the two Journal notes published in our issues of August 7th and 21st, in which we summarised Professor F. G. Donnan's plea for the hydrogenation process and Sir Harry McGowan's statement of the technical position, we have to record that on Tuesday last the Billingham experimental hydrogenation plant of Synthetic Ammonia and Nitrates, Ltd., was inspected by a number of colliery proprietors and mining experts from the Durham and Northumberland coalfields. The visitors saw the washing of the raw pit coal, and the process of grinding the rough slack or nuts and mixing them with a proportion of oil. They also viewed the heavy steel vessels into which the mixture is injected into an atmosphere of hydrogen under a very high pressure. The control of the process is such that the proportion of petrol to the heavier oils can be varied as may be desired. The final process of refining the motor spirit and the return of the heavier oils to produce more petrol was also seen. The motor spirit so produced is regularly used in the works motor vehicles, and it is reputed to be of a superior quality. As previously recorded, the only difficulty with which Synthetic Ammonia and Nitrates, Ltd., is now faced is the present low price of petrol, which, if only increased a very small amount as regards retail sales, would, it is claimed, cause the hydrogenation process to become a commercial success. It is expected that before long, further new works will be erected at Billingham for the manufacture of motor spirit from oil on a large scale.

The Shipping, Engineering and Machinery Exhibition at Olympia.

No. III.*

THE DOMINION MACHINERY COMPANY, LTD.

UP in the gallery the Dominion Machinery Company, Ltd., of Hipperhulme, Halifax, England, has a display of woodworking machinery in operation that includes some machines with which we have dealt before and the two illustrated in Figs. 58 and 59.

The vertical spindle moulding machine shown in Fig. 58 is what might be described as of the integral type, but the motor is arranged outside the frame, so that a motor to suit the local electricity supply

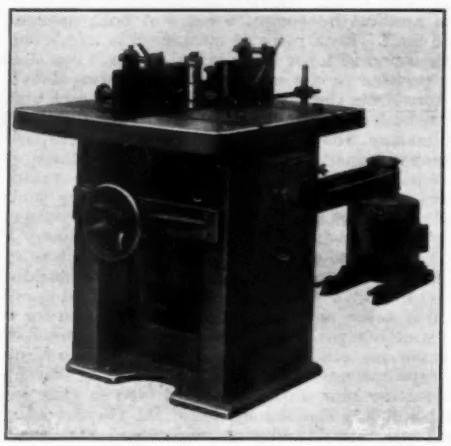


FIG. 58—WOOD MOULDING MACHINE—DOMINION

can be readily adapted. It will be noticed that the motor is of the vertical spindle type and, consequently, the belt needs no guide pulleys. The cutter spindle runs in ball bearings, which are fitted in a slide that can be raised and lowered in the frame. The slideways are equipped with adjustable steel strips. The table is 32in. square, and is reversible. It is fitted with loose rings, allowing for various sizes of cutters to be used. Planed grooves are provided for sliding the fences, which are independent and adjustable by means of a fine thread hand screw. Sliding plates are fitted to the front of the fences, which are 6in. deep and built proportionately. The gap can be set as desired. The top piece is loose and can be interchanged with a French spindle if desired. These spindles are fitted with a conical neck and drawn into position by a heavy screwed cap. By this method the spindle, which is 1¼in. diameter, is always true. The hand wheel for raising and lowering the spindle is arranged, as will be seen from the illustration, in

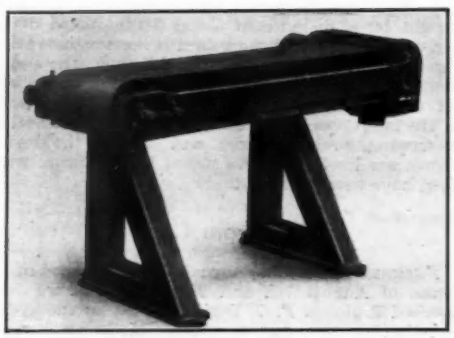


FIG. 59—SANDING MACHINE—DOMINION

a convenient position at the front of the machine. Spring pressure bars are arranged in front of the fences to keep the work up to the cutter.

The sanding machine which we illustrate in Fig. 59 has ball bearings at both ends of both spindles, and these bearings are dustproof, so that it can be safely run at high speeds. The band-tightening arrangements on either end of the idler pulley are independent, so that differences in the stretch of the two sides of the band can be eliminated. The table is also adjustable to allow the band being run tight or slack. The guard over the driving end can be easily removed to allow long pieces of work to be sanded. It will be noticed that the A frames are made vertical in front, so as not to impede the workman. The machine is made in three sizes, with tables 22in. by 9½in., 45in. by 12½in., and 45in. by 14½in. respectively.

The Super Elliot woodworker, which we have described before, has just recently been improved by the addition of a new guard to the driving belts that completely guards the machine and protects the operator. This machine is claimed to do far more operations, with considerably less time to change over, than any other combination machine made. Amongst its capabilities are the following operations, viz.: Ripping, cross cutting, mitring, compound mitring, surfacing and thicknessing, rebatting, chamfering, stop chamfering, moulding, tenoning, ploughing, grooving, boring, stair stringing, &c.

* No. II. appeared September 18th.

HANCOCK AND CO., LTD.

In recent years there has been a great development in the design of oxygen-cutting machines. It is not so very long ago that all such cutting was done entirely by a hand device. Modern machines, however, have the appearance and work almost to the accuracy of machine tools. They are well exemplified by exhibits on the stand of Hancock and Co., Ltd., of Croydon. In Fig. 60 a large machine for cutting from a template made from strip metal is illustrated. It can be fitted with one, two or three heads, each of which works independently. An electric motor of 1/50 H.P., on each head, drives two serrated wheels, which engage one on each side of the template strip. The distance between the two wheels, and the pressure they exert on the template, can be adjusted while the speed of traverse is also adjustable to suit the requirements of various thicknesses of the metal to be cut. The cutting pipe is remotely controlled. Once the preheating gas has been set by a fine adjustment, the movement of a single lever is all that is necessary to start or stop a cut. The cutting pipe is rigidly connected to the tracer, and has also a vertical adjustment so that irregular thicknesses of the plate being cut can be followed. The driving motor is mounted on a light trolley, which also supports the cutting pipe. This trolley can traverse along bars which are mounted on wheels running on rails in a direction at right angles to that in which the trolley can travel. Thus, any flat shape can be traced. This machine is made in standard sizes having cutting areas of 18ft. by 3ft. or 5ft., and 10ft. by 3ft. or 5ft. On the stand one size is shown in operation.

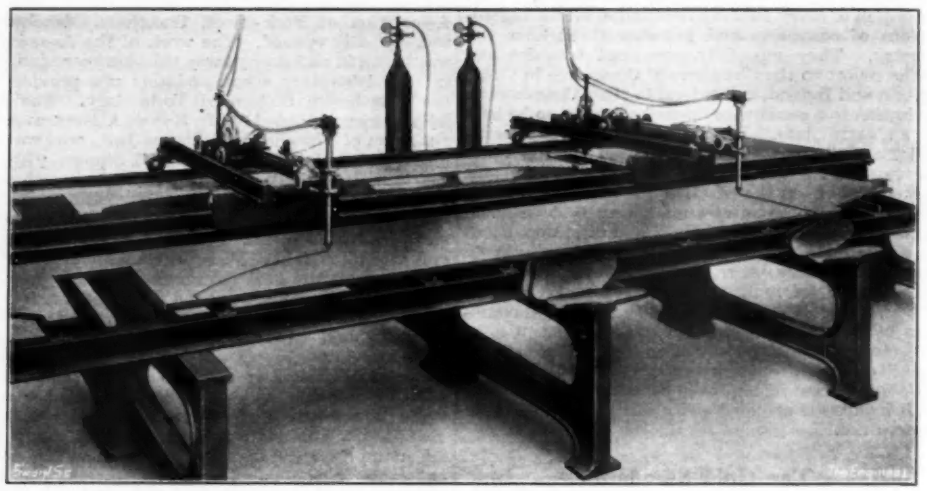


FIG. 60—MULTIPLE HEAD OXYGEN CUTTING MACHINE—HANCOCK

The firm's new "Reflex" profiling machine is of particular interest, since the operator can sit at his job some distance from the actual cutting table at the same time retaining complete control of all the operations. In Fig. 61 we reproduce a photograph of the machine shown at the Exhibition. A vertical post is carried upon a bracket jutting out from the heavy base. Two parallel horizontal bars are mounted upon the post in such a way that they can swing freely in a horizontal plane. Supported across the bars there is on one side a crosshead carrying the burner, and on the other a small electric motor supplied from the lighting circuit, which drives a serrated wheel through gears. This wheel bears lightly upon a table upon which a blue print or other tracer guide can be placed. To follow out the shape the operator has only to turn the serrated wheel in such a way that it traverses itself along the lines. At each end of the parallel horizontal bars there is mounted a pulley wheel and around these runs an endless cable. The crossheads carrying the motor and the cutting pipe are attached to this cable in such a way that if one moves outwards so does the other. That is, as seen in the engraving, the motor crosshead is connected to the further cable, while the pipe crosshead is connected to the nearer. The crossheads are, of course connected to the cables at points equidistant from the centre post. The controls are all arranged at the copying end of the machine, those for the burner included. If a very large plate is to be cut, the horizontal bars and centre-post can be removed and supported upon a tripod mounted upon the plate itself. Or, if a long, straight cut, greater than the capacity of the machine can deal with, has to be made, the centre-post can be mounted on a carriage capable of moving along a straight rail.

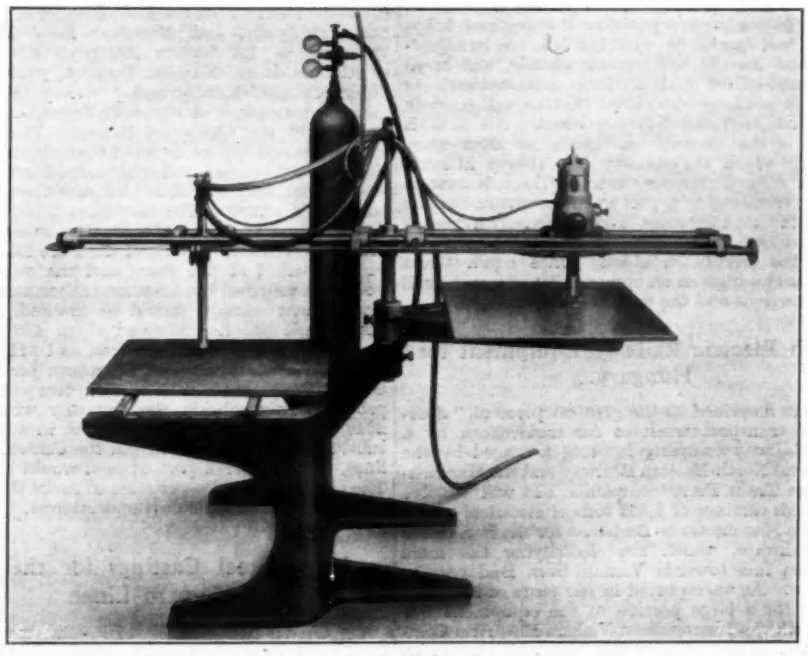


FIG. 61—OXYGEN PROFILING MACHINE—HANCOCK

The firm is also showing a machine of the more usual type, with the cutting arm mounted directly below the tracer arm. This machine is also driven

by a small electric motor. A device for mounting upon a beam and cutting straight, unlimited lengths of metal, is shown in Fig. 62. This machine also is motor-driven, and has hand control for the level of the cutting pipe to suit varying thicknesses of metal.

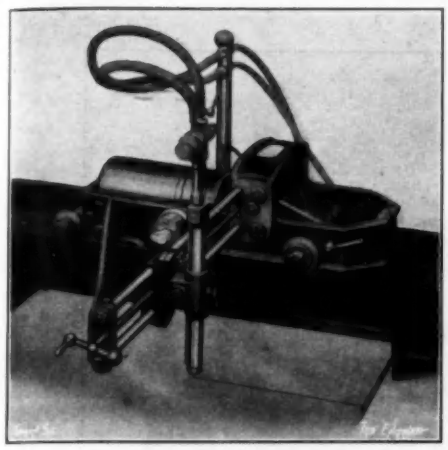


FIG. 62—STRAIGHT LINE CUTTER—HANCOCK

The cutting pipe is traversed towards and away from the beam by hand for setting to the line.

REAVELL AND CO., LTD.

The display of air-compressing machinery and air-driven auxiliaries, together with air-control instruments, which is shown on the stand of Reavell and Co., Ltd., of Ranelagh Works, Ipswich, is outstanding on account of its very comprehensive character. Among the types of compressor shown are reciprocating piston machines working on the single and the double-acting principle, and several types of rotary compressor, as well as a two-stage turbo-compressor.

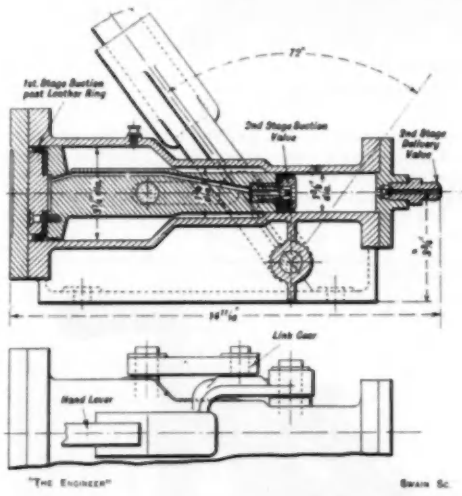


FIG. 63—HAND-OPERATED COMPRESSOR—REAVELL

We have chosen for description a few machines out of the twenty-one exhibits which will, we hope, indicate some of the improvements in design now taking place.

Among the smaller units is the hand-operated horizontal single-stage compressor illustrated in Fig. 63, which has been designed to provide an inexpensive machine for marine and land use for oil engine work. It enables an auxiliary receiver to be charged, which in turn facilitates the starting of an auxiliary engine in a ship, so as to furnish air to start the main engines. It is intended to deal with cases which may not happen, but where, through inadvertence, all of the air has been lost and power-operated compressors, therefore, cannot be started for want of a small supply of highly compressed air for starting purposes. The method of operation will be clear from our illustration. On the forward stroke air is entrained at the crosshead pin and passes along a slot over the bucket leather to the first-stage cylinder. On the backward stroke the air is compressed and is then forced through the piston to the second-stage suction valve in the forward face of the piston into the second-stage cylinder, where further compression takes place. The machine, which weighs only about 55 lb., is intended to work at about sixty double strokes per minute and is designed to deliver air at 450 lb. pressure, which pressure is generally ample to start the usual type of auxiliary oil engine. This type of machine has been in use on the Continent, but it is new, we believe, to this country.

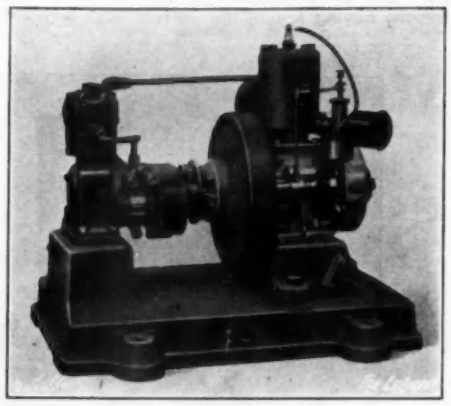


FIG. 66—EMERGENCY AIR COMPRESSOR—REAVELL

Another emergency charging compressor for land and marine oil engine installations is that shown in Fig. 66. It is a single-stage water-jacketed compressor of simple design with a maximum delivery pressure of 450 lb. per square inch. It is coupled directly to a 1½ B.H.P. Villiers engine and is mounted on a common base plate. The set is designed to charge a starting air receiver of 1 cubic foot capacity to 450 lb. per square inch in twenty minutes, or a lower pressure of 250 lb. per square inch in about eleven minutes. Two-stage air compressors of this type for 450 lb. pressure have been fitted on practically all the recent large motor yachts constructed in this country.

The general features of a small power-driven compressor of the type above referred to are shown in drawing Fig. 67, which illustrates a 350 lb. pressure hopper-cooled air compressor for air receiver charging or other similar uses. The piston has a displacement of 5·2 cubic feet per minute when running at 750 r.p.m., and the set is designed to charge a receiver of 2¾ cubic feet capacity from 200 lb. up to 350 lb. pressure in ten minutes. The compressor as exhibited at Olympia is driven by a 1½ B.H.P. Petter petrol or paraffin engine, but it can equally well be arranged for belt or direct motor drive.

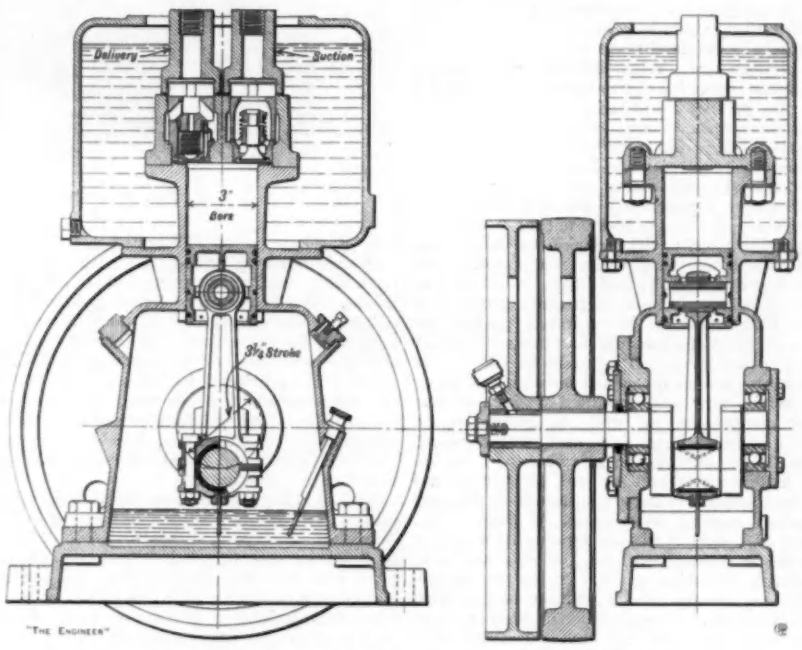


FIG. 67—SMALL POWER-DRIVEN COMPRESSOR—REAVELL

A machine of a different character is the new size of portable air compressor shown in Fig. 64. It is smaller than other similar machines marketed by the firm and is intended to supply the need for a reliable and robust compressor for spray painting, for operating a small number of caulking tools or for bridge cleaning, &c. A number of machines of this type have been built for the London and North-Eastern Railway

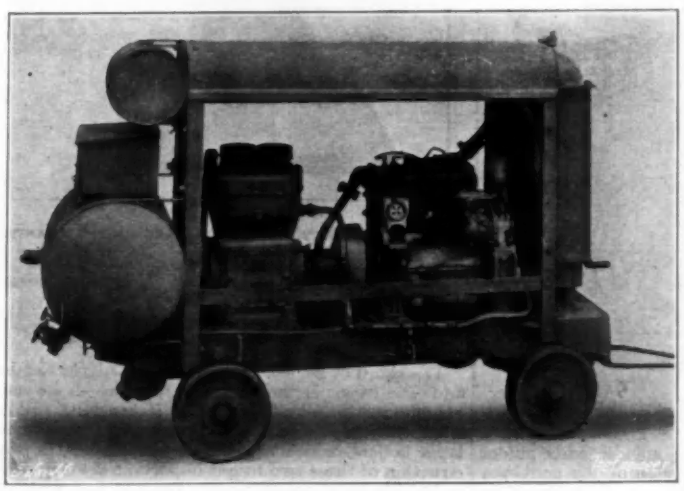


FIG. 64—PORTABLE AIR COMPRESSOR—REAVELL

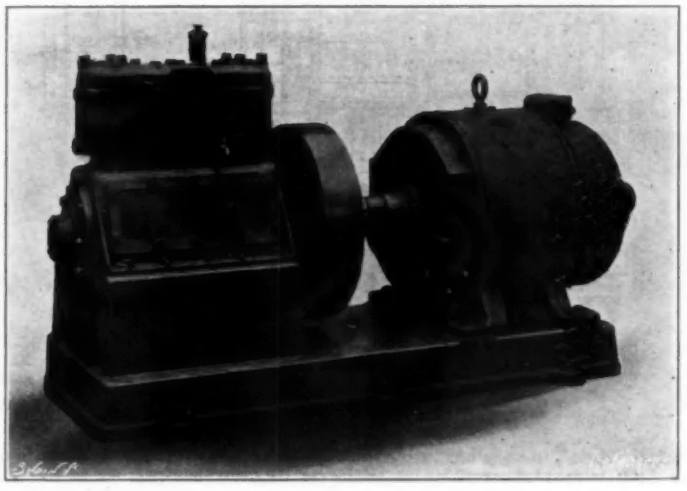


FIG. 65—MOTOR-DRIVEN COMPRESSOR—REAVELL

Company. The compressor has been specially designed for continuous high-speed operation, and a test unit ran in the Ipswich works for over two months at 1500 r.p.m. The adoption of a modification in the firm's standard plate valve has enabled a rated speed of 1400 r.p.m. to be adopted with very satisfactory results. The compressor has a piston displacement of 54 cubic inches with a working pressure of 100 lb. per square inch. It is driven by a four cylinder petrol-paraffin engine by Coventry Climax Engine, Ltd., which has a bore of 69 mm., a stroke of 100 mm., and is designed to work at 1400 r.p.m. The set only weighs 17½ cwt. and is very neat in design, being carried on 12in. road wheels.

Another exhibit of more than usual interest, illustrating the progress made in high-speed compressor design, is the two-cylinder single-acting air compressor designed for 100 lb. delivery pressure, which has piston valve-controlled air inlets. A drawing of this machine is reproduced in Fig. 68, while in Fig. 65 we show a view of the same compressor coupled to a 12 B.H.P. Bull motor, which is designed to run at 440 r.p.m. The compressor has a bore of 6in. with a 4½in. stroke and works at 1000 r.p.m. The scantlings and reciprocating parts are standard in design, but the novel feature is the fitting of two excentrics on the crank shaft, which, by means of piston valves, control the air inlet to each cylinder. Such an arrangement has given a considerably higher volumetric efficiency compared with a high-speed compressor using plate type valves. The piston valve avoids the attenuation associated with spring-loaded valves. Another improvement consists in the arrangement whereby the top edge of the piston valve, uncovers a delivery port, the compressed air passing over the top of the piston valve as it leaves the cylinder and issuing through a standard plate valve placed on the top of the piston valve. When the compressor piston has reached the top of its stroke the piston valve, by reason of the ordinary setting of an excentric in relation to the crank, is only about halfway on its upward path. The result is that, as the piston is on its downward stroke the piston valve continues moving upwards so that the remaining imprisoned delivery air is pushed out through the delivery valve at a slow rate, namely, the rate of travel of the piston valve which is moving slowly with relation to the piston. It is clear, therefore, that when the piston valve reaches the top of its stroke and begins to return the plate delivery valve will seat itself quite gently and noiselessly. The machine is exhibited running at Olympia, and its silent running has been remarked upon by those who have seen it in operation.

Other exhibits, which space will only permit us to describe, include new and modified designs of the quadruplex compressor, as well as rolling drum rotary compressors, both air and water-cooled. A further large exhibit is a two-stage turbo-blower of 10,000 cubic feet of free air per minute capacity, designed for 10 lb. per square inch delivery pressure when running at a speed of 5450 r.p.m. and taking 515 B.H.P. It is arranged for direct coupling to a steam turbine or to an A.C. motor through reduction gears. A feature of the machine is the variable angle diffuser blades with which it is furnished. These enable the blower, when it is direct coupled to an A.C. motor running at a constant speed, to vary efficiently the volume of the air dealt with while working at the same delivery pressure.

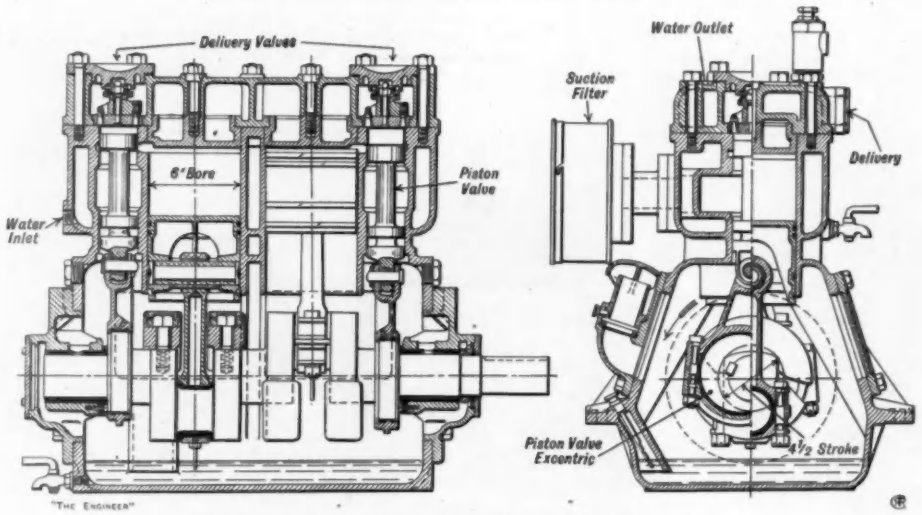


FIG. 68—SINGLE-ACTING AIR COMPRESSOR—REAVELL

The firm is also showing models of the Reavell Askania regulators, which were described in THE ENGINEER of February 17th, 1928, and a range of air-operated deck auxiliaries, which were illustrated in our issue of September 27th, 1929.

TECALEMIT LTD.

Many of the products of the firm of Tecalemit Ltd., of the Great West Road, Brentford, are already well known to our readers. Two recent productions exhibited upon its stand, however, merit some description. The first of these is a device for the automatic lubrication of a large number of points such, for instance, as may be found in a rolling mill equipment. The device consists of a container for the lubricant, having around its bottom edge a double row of grease guns. The guns are operated by an excentric working within the container and driven by a worm and wheel from a shaft outside the container. The drive can be taken from any convenient point on the mechanism to be lubricated, and the guns will deliver a charge of lubricant once in every thirty revolutions of the driving shaft. In order to force the lubricant into the guns, a device having the appearance of a fan with a number of blades of somewhat high pitch is mounted within the container above the excentric. The blades are so inclined that the lubricant is forced downwards. This device is shown in operation.

Another mechanism has been designed with the object of automatically lubricating the various points of conveyors, escalators, &c. The lubricator is fixed in any convenient position alongside and level with the travelling nipples. A container with a capacity of about 15 lb. of lubricant is connected by a flexible joint to the grease gun. As the nipple on the conveyor approaches the mechanism, a claw attachment which engages the spindle ends guides the gun on to it. The movement of the conveyor carries with it the gun, which is mounted upon a slide arm, and by means of a suitable mechanism the charge is compressed and delivered. At the completion of the stroke, the gun automatically disengages itself, the claw attachment also is released, and a spring returns the gun to the "ready" position. This device is illustrated in Fig. 69.

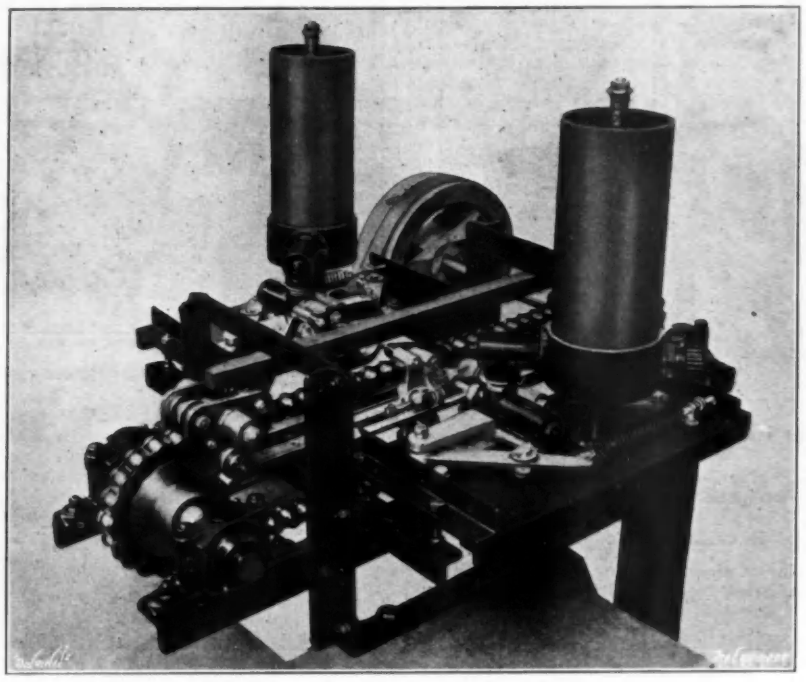


FIG. 69—AUTOMATIC CONVEYOR LUBRICATORS—TECALEMIT

F. J. EDWARDS, LTD.

On the stand of F. J. Edwards, Ltd., 406, Euston-road, London, N.W. 1, there is an extensive range of sheet metal working machines and tinsmiths' tools, including the little throatless rotary shearing machine illustrated in Fig. 70. Its construction hardly needs comment, as the illustration shows the conical rotary cutters and their bevel drive so plainly. The main casting is of malleable steel. It is made in three sizes to cut No. 18, No. 16 and No. 12 gauge steel, and does its work quite easily. It will, of course, cut straight or curves, as the contact with the two cutters is quite short, and can be readily fitted with a circle cutting attachment. There are also on this stand a number of power, hand and foot presses, swaging machines, bending rolls, &c.

FIG. 70—ROTARY SHEARING MACHINE—EDWARDS

BABCOCK AND WILCOX, LTD.

The stand of Babcock and Wilcox, Ltd., of London and Renfrew, is noteworthy for two large-scale exhibits relating to the firm's new Babcock SX marine small-tube boiler and the Bailey furnace walls for large boilers, which models give details of the construction of these two recent important developments in British boiler engineering. Dealing first with the new SX boiler, we may refer to the account of it already given in THE ENGINEER of January 9th, 1931. It may be recalled that this sectional express type boiler was originally designed and built at the American works of the Babcock and Wilcox Company and was tested by Commander J. G. Broshek, of the United States Navy, who obtained boiler, superheater, and furnace efficiencies of 84·62 to 82·75 per cent. when burning 0·25 lb. to 1 lb. of fuel oil per square foot of heating surface and operating the boiler at

300 lb. pressure. At 600 lb. pressure overall efficiencies of 82 per cent. were obtained, all the tests being made without air heaters.

The boiler has now been developed for the British market by the Renfrew works, where the model shown on the stand—see Fig. 73, and the full-size two-section boiler shown in Fig. 72—were built. The two-section model shows the steam drum and the front and back cross boxes. Fig. 72 shows the model ready packed for rail transport with wooden supports between the tube nests and tubes. There is also under construction at Renfrew a boiler of this type for H.M.S. "Guardian," a combined net layer and target towing vessel now being built for the Admiralty at Chatham Dockyard. This particular boiler, which will shortly be ready for testing, will have a heating surface of 5850 square feet and a working pressure of 250 lb. per square inch. Its designed output will be about 91,000 lb. of steam per hour, with an oil consumption of 1 lb. per square foot of heating surface per hour. It will occupy a floor space of 138 square feet and the steam output works out at 650 lb. per hour per square foot of floor space from and at 212 deg. Fah.

The drawing we show in Fig. 71 indicates clearly the arrangement of the drums and tubes. As regards circulation, the boiler follows to a large extent the normal practice of the firm, particularly as regards the steam drum and auxiliary fittings. The headers are cylindrical in shape, each element comprising two headers and an associated tube bank. The lower portion of the boiler heating surface consists of a tube screen with the tubes expanded into the bottom horizontal water drums. As will be seen from the drawing, the lower rows of tubes are 2in. in diameter with three rows of 1¼in. diameter tubes above them. Superimposed upon the horizontal drums are vertical or inclined headers, which are connected to the drums by nipples and are further connected to the steam drum by vertical pipes in the front series of headers and by horizontal pipes in the back inclined headers. The interconnecting small-bore tubes between the headers are 1in. diameter for naval boilers, and may be 1¼in. diameter for industrial boilers. All these tubes are fully submerged. The lower pipes from the inclined headers permit circulation between the headers and the drum, while the upper pipes serve as a passage for the generated steam. The curved tubes permit, it is claimed, a uniform rate of gas flow, and all parts are so contrived that they are easily examined, as will be seen from the back view of the model, Fig. 73, which shows some of the inspection doors removed. As our drawing Fig. 71 shows, the superheater is placed above the lower nest and consists of a series of 1½in. diameter tubes expanded into two drums. The model shown at Olympia is furnished with a furnace front and oil burner of the standard Babcock design, but in the "Guardian" boiler Admiralty type burners will be fitted.

Passing reference need only be made to the Bailey water-cooled furnace wall, which consists of refractory-faced blocks clamped to 3½in. dia. tubes for furnace walls and bare metal blocks for the lower wall parts of furnaces where adhesions of ash and clinker must be avoided. We show in Fig. 74 a view of the full scale model exhibited on the stand which clearly illustrates the various features referred to.

An example of such construction will be found in the six 312,800 lb. per hour Babcock boilers for Battersea

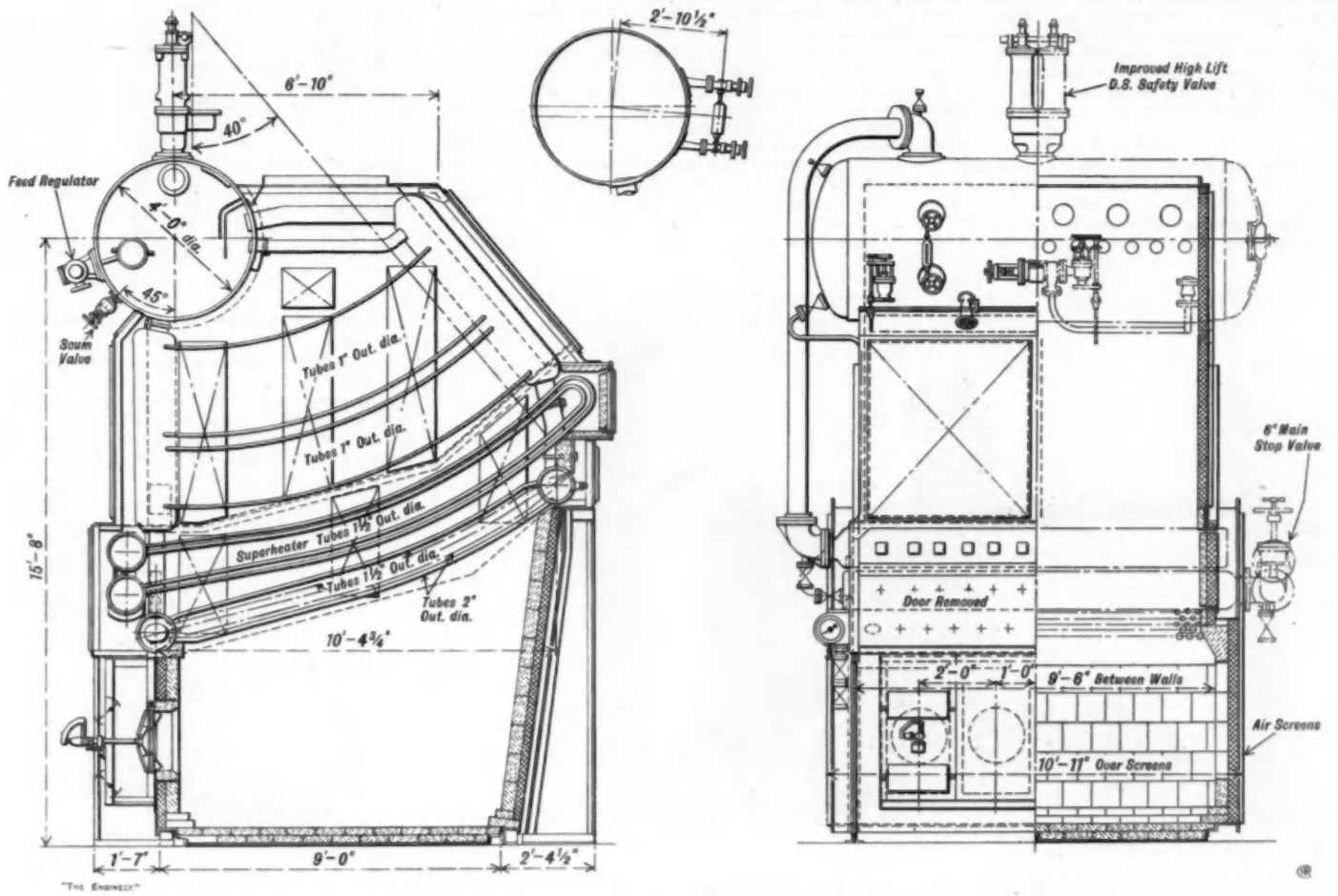


FIG. 71—SECTIONAL EXPRESS TYPE MARINE BOILER—BABCOCK

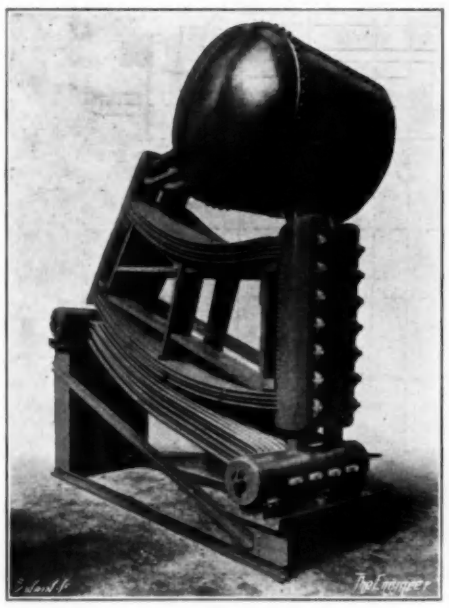


FIG. 72—TWO-SECTION BOILER—BABCOCK

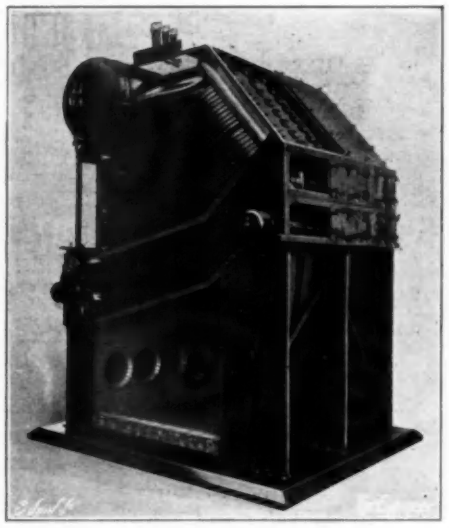


FIG. 73—MODEL OF BOILER—BABCOCK

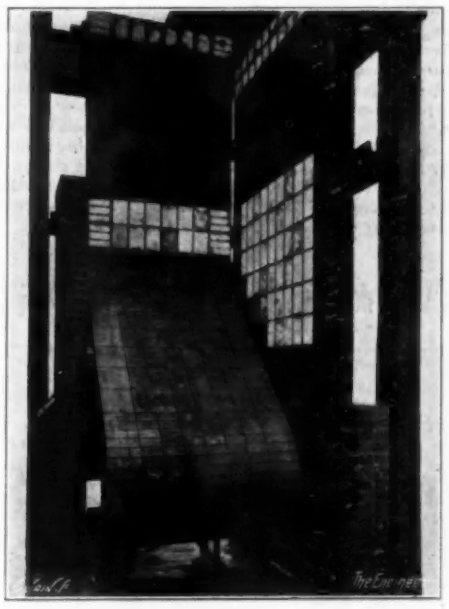


FIG. 74—BAILEY FURNACE WALL—BABCOCK

power station, which have a working pressure of 615 lb. and a final steam temperature of 875 deg. Fah. Details of the construction can be studied by the aid of the large sectional model and photographs of many recent installations. The firm is also exhibiting products of its low-temperature carbonisation plant, which was fully described in THE ENGINEER of October 12th, 1928. Another interesting section of the exhibit is a display of calorised pressed steel boxes and pots for case-hardening, annealing, cyanide, lead and salt hardening, also calorised solid-drawn steel pyrometer sheaths. Samples of similar articles made in the special high-temperature and corrosion-resisting alloy Calmet, which is of the chromium-nickel and aluminium alloy group, are also on view.

GILLESPIE PARTNERS, LTD.

One of the exhibits of Gillespie Partners, Ltd., of Cecil House, Holborn Viaduct, is an electric elevating truck, which can be used for transporting and stacking goods. The rated capacity of the truck exhibited, which is shown in Fig. 75, is 2 tons,

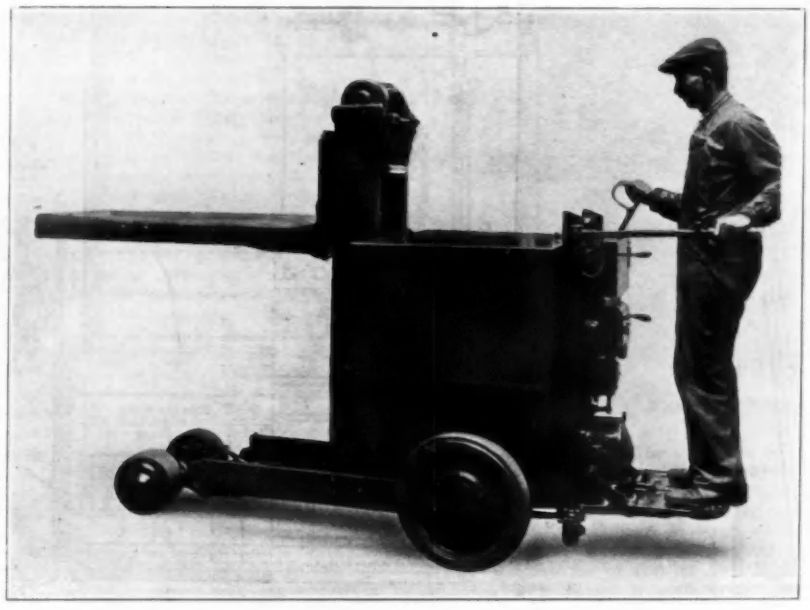


FIG. 75—ELECTRIC ELEVATING TRUCK—GILLESPIE

and there are three travelling speeds in either direction, the actual speeds depending upon the battery selected. The elevating speed varies from 9ft. to 18ft. per minute. The dimensions of the truck are:—Width, 38in.; height, 83in.; and length, 103in.; with the operating pedals folded and the steering handle in the "up" position. The platform is 36in. wide by 54in. long and when it is lowered it stands 11in. above the floor level. When it is elevated by the separate elevating motor it stands 81in. above the floor. There is a two-wheel drive, the motor being connected directly to worm gearing. The motor-driven hoist elevates the platform by means of double two-part cables, with an automatic slack take-up and equaliser. One pedal is provided for operating the brake, and another for actuating the power switch. Travel motor and lift motor controller handles are fixed on the right of the driver, and the steering handle, which carries a push-button, on the left, as shown in the illustration. Edison or Exide Ironclad or other batteries can be fitted. With the average size of battery the weight of the truck is 3400 lb.

BENES LTD.

Within recent years there has been a marked tendency not only towards the development of oil

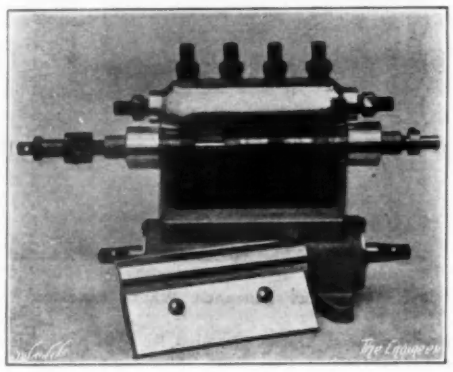


FIG. 76—FUEL PUMP—BENES

engines working on the solid injection system, but also towards the construction of such engines capable of running at speeds comparable with those of petrol engines. In consequence, a demand has arisen for reliable fuel pumps capable of working satisfactorily at these high speeds and responsive immediately to the movements of the governor.

The photograph reproduced in Fig. 76 illustrates the latest type of fuel pump, designed by Benes Ltd., of 24, Holborn, London, to meet the modern requirements of high-speed oil engines. The construction is shown in the drawings Figs. 77, 78 and 79. Each individual plunger is driven by a cam running at one-half or full engine speed, according to whether the cycle employed is four-stroke or two-stroke. Turning to Fig. 78, it will be seen that the pump itself consists of three parts. There is an outer member, having at its upper end suction and relief ports. The plunger fits the bore of this exactly in the upper part, but below it fits in a sleeve which itself is forced into the bore of the outer portion. The plunger rising and falling draws the oil through the suction ports and delivers it *vid* the ball type non-return valve—to be seen in Fig. 77—to the sprayers. The sleeve in which the plunger slides has cut into its upper edge two triangular slots, one side of each of which is vertical. As the sleeve abuts against the shoulder of the outer member triangular ports are formed. The fuel in the cylinder can pass by means of a hole down the centre of the plunger, and through a cross hole into the slots in the sleeve, and so back to the suction chamber. The point of the stroke at which this by-pass passage opens can be altered by rotation of the plunger. The governor is, therefore, arranged to rotate the plunger by the following mechanism.

It will be seen from the drawing, Fig. 77, that the governor rod is screwed with a fine thread and carries a number of members in the form of cylindrical racks upon the threads. Movement of each rack is prevented by a small sheet of spring steel, one edge of which fits into a slot in the rack, thus preventing it turning and, consequently, moving along the thread on the governor shaft. Each rack is in connection with a gear wheel, which carries below it a sleeve having a

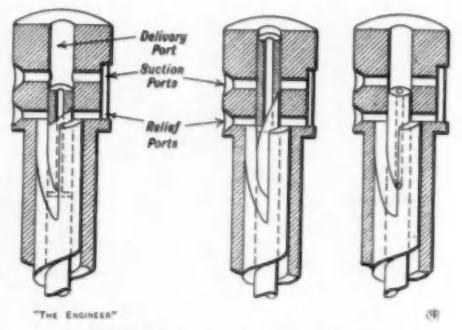


FIG. 78—DETAILS OF PUMP—BENES

slot cut on each side at its lower extremity. The bottom of the pump plunger is formed with two projections, which fit into the slots just mentioned. Thus an alteration in the position of the governor weights moves the governor rod and hence the racks, which, gearing with the gear wheels, rotate the sleeve,

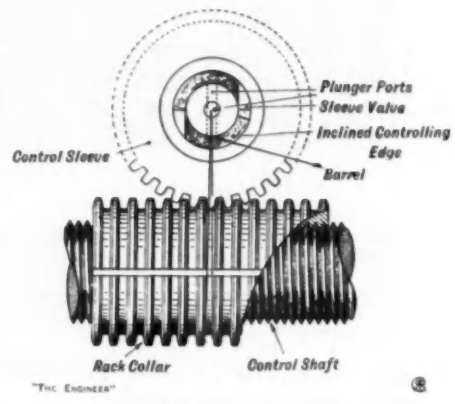


FIG. 79—RACK CONTROL

and consequently the plunger. Rotation of the plunger, as explained in the previous paragraph, alters the moment at which the fuel in the cylinder can be by-passed back into the suction chamber instead of passing on to the sprayer.

The function of the cylindrical racks has not yet, however, been fully described. We have said that they are prevented from moving along the governor shaft by means of light springs fitting into slots. There are four of these slots, equally spaced round each rack. By lifting the spring out of connection the rack can be turned on the governor rod, and since it is mounted by a fine screw thread, will traverse

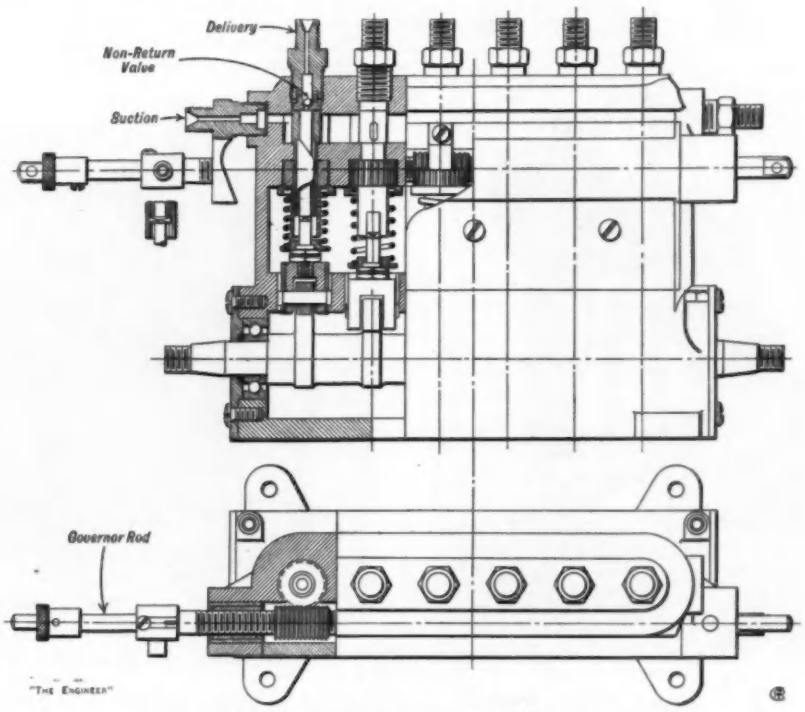


FIG. 77—GENERAL ARRANGEMENT OF FUEL PUMP—BENES

along it, carrying with it, of course, the gear wheel and rotating the pump plunger. It can be set in this way in any position relative to the governor rod, thus providing an individual and accurate adjustment of the amount of oil injected into each engine cylinder by each fuel pump.

The pump is neatly and accurately constructed and the movement of the governor rod is smooth and easy. It is capable of delivering fuel at a pressure of 700 atmospheres, or more than 10,000 lb. per square inch.

The firm is also showing a sprayer of commendably neat and compact design. To illustrate the capabilities of this device the manufacturers are showing a small single-cylinder engine, originally designed to work with petrol on the two-stroke cycle, fitted with a pump and sprayer, also made by Benes Ltd., which we were informed, has been worked satisfactorily at a speed of 3000 r.p.m. as a solid injection oil engine. Modifications, of course, had to be made in the design of the cylinder head.

MUREX WELDING PROCESSES, LTD.

For a number of years Alloy Welding Processes, Ltd., and the Premier Welding Company, Ltd., have shown their goods at the Shipping, Engineering and Machinery Exhibition, but on this occasion the firms are exhibiting under the name of Murex Welding

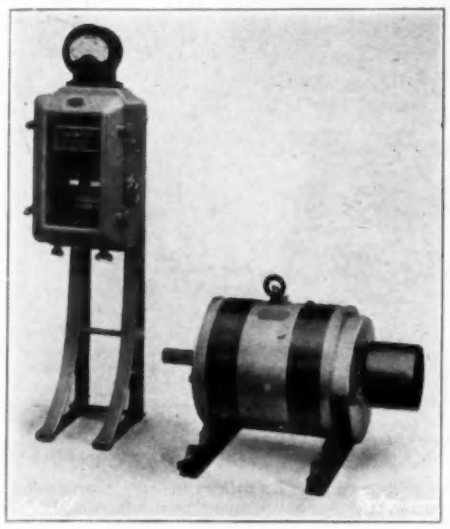


FIG. 80—BELT-DRIVEN WELDING SET—MUREX

Processes, Ltd., of Forest-road, Walthamstow, a firm that now incorporates the two businesses. Besides ordinary arc welding plant, machines for automatic and semi-automatic welding are shown, including a profile automatic welder, an automatic straight line welder, an atomic hydrogen plant, and a continuous feed weider. There are two single-operator welding motor generator sets, with simple switchgear, and single-operator welding generators arranged for belt driving, as shown in Fig. 80, and a similar machine driven by an engine made by Morris Motors,

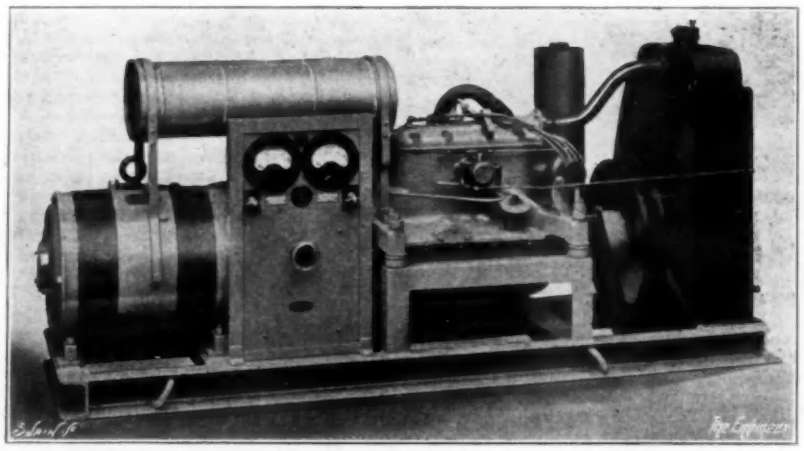


FIG. 81—PETROL-DRIVEN WELDING SET—MUREX

Ltd., as shown in Fig. 81. The engine is a four-cylinder 12 to 14 H.P. petrol machine, designed for a speed of 1500 r.p.m., and provided with a Lucas magneto, a Smith carburetter, a sensitive governor, a 7-gallon fuel tank, and a radiator cooled by a fan, directly coupled to the engine shaft. The principle on which the welding generators—shown in Figs. 80 and 81—operate, was fully described in our issue of October 5th, 1928. A Metro-Vick transformer set with a choking coil combined for A.C. welding, welders' equipment, such as masks and electrode holders, and examples of welded articles, constitute other exhibits.

As regards the automatic arc welding equipments, the welding head carrying the electrode follows a prescribed course, determined by the carriage path, and the work to be welded is set up so that the seam lies directly under the line of travel. Repetition work with the aid of suitable jigs and clamping arrangements naturally lends itself better to the system than work of irregular character. If the necessary conditions can be complied with, the advantages are greatly in favour of automatic operation, and can be enumerated as follows:—(1) Increased speeds, owing to the use of higher current values than can be employed with hand welding; (2) better penetration and a smaller number of passes for welding any given thickness of material, and (3) neater appearance and a sounder weld, owing to elimination of the human element.

One of the main drawbacks of automatic operation,

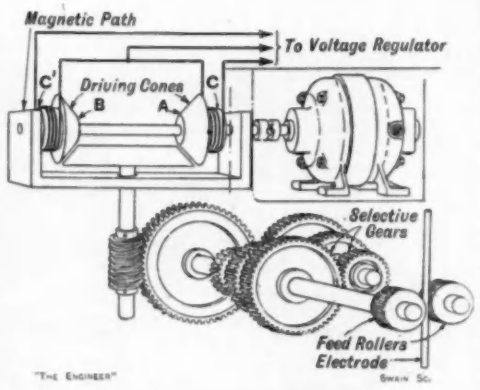


FIG. 82—ELECTRODE FEED GEAR

until quite recently, was the fact that only bare wire electrode could be used in the machine; but this drawback has now been overcome. The Metro-Vick equipment exhibited consists of an automatic welding head with a control panel, a travel carriage for carrying the head over the seams to be welded and suitable clamping arrangements for holding the work in position.

The automatic welding head which is the main part of the machine, consists of a small constant-speed motor, which drives a pair of knurled steel feed rollers through a reversible magnetic cone clutch and a set of reduction gears. The feed rollers feed the electrode to the arc through a nozzle which forms the electrical connection between the electrode and the generator.

Referring to Fig. 82, the feed rollers are driven through a selector reduction gear-driven cone, and one of the driving cones A or B. When the coil C is energised, the cone A is magnetised and pulled into contact with the selector cone, thus driving the feed rollers which feed the electrode downwards. The coil of a voltage regulator is connected through an adjustable regulator across the arc, one terminal being connected to the work and the other to the electrode. According to the length of the arc and, consequently, the voltage across it, the voltage regulator operates to energise the coil C or C^1. Thus, if the arc tends to become too short, the rate of feeding the wire is decreased by the coil C being energised, and the electrode is drawn back a small amount. As the electrode is deposited on the work and the arc becomes longer, the coil C^1 is energised and the wire is fed forward. Thus, there is constant automatic adjustment of the rate of electrode feed, keeping the length of the arc at a predetermined value. To make an automatic weld a relative motion between the welding head and the work must be produced either by mounting the head in a fixed position and moving the work beneath it, or by mounting the head on a carriage which follows the seam to be welded.

Since the bulk of fluxing materials used in the manufacture of covered electrodes are either insulators or very bad electrical conductors, it will readily be seen that the welding current cannot be conducted to the electrode at the nozzle, as in the case of bare wire: nor is it practicable to pass the current through the whole length of the coil of electrode on the drum. In any case, with a given gauge of electrode, high rates of deposition are only possible when the point of contact is kept close to the electrode tip, otherwise overheating of the electrode due to the resistance of the core wire will result. Most automatic welding, the makers of the machines under consideration explain, is carried out with a backing strip or chill bar positioned on the under side of the seam to prevent burning through with the high current values employed, and unless these conditions are complied with, automatic operation loses some of its attractiveness. Welding on a chill bar definitely influences the structure and soundness of the weld metal, and introduces other disadvantages.

With a view to securing better results, Murex Welding Processes, Ltd., have been giving attention to

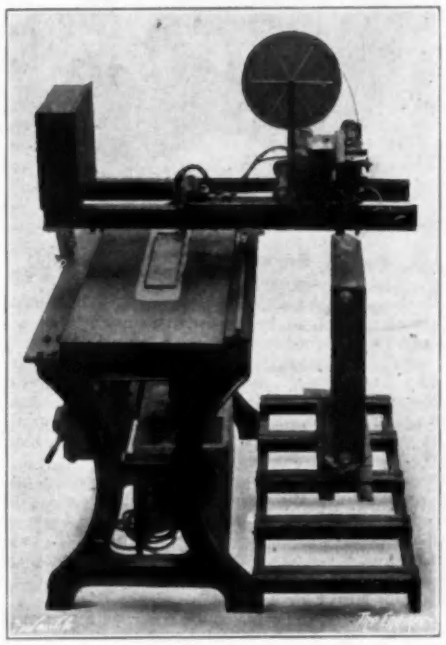


FIG. 83—AUTOMATIC ELECTRIC PROFILING MACHINE—MUREX

the production of an electrode specially adapted to automatic welding, and very favourable results with this electrode are said to have been secured. The fully automatic profile welding machine—see Fig. 83—is designed on the lines of the automatic gas-cutting machine, in which the copying arm follows a prescribed path set up by a template, with which rollers engage.

THOMPSON BROTHERS (BILSTON), LTD.

Among the exhibits of Thompson Brothers (Bilston), Ltd., of Aldwych House, London, is a new rotary displacement pump, intended for use with light and heavy oils in particular, but also suitable for pumping other liquids. In Fig. 84 we give a drawing of the

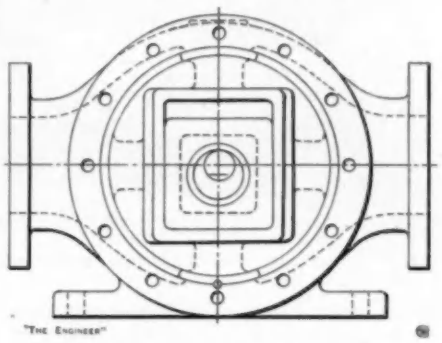


FIG. 84—ROTARY PUMP—THOMPSON

pump with the end cover removed. Within an outer casing having suction and delivery branches, a circular member with a square hole in its centre and ports opening into the centre on each of the four sides is connected to the driving shaft, and can rotate. A rectangular piece having ports in its shortest sides and a rectangular hole cut axially through it can reciprocate within the square hole of the rotating member. Within the rectangular hole in the last-mentioned part a square block is mounted upon an excentric

pin. Thus when the rotating member turns, the two parts within reciprocate, the alterations in the spaces between the various parts providing a pumping action which is equivalent to that of a duplex double-acting pump, with cranks at 90 deg. Suction and delivery take place over an angle of about 120 deg., and the remaining arcs of 60 deg. form the seal between the delivery and suction sides. The photograph reproduced in Fig. 85 shows the external appearance of a horizontal pump.

The design is such, it will be seen, that the leakage paths are long and live contact is avoided. In consequence, it is claimed that the pump has a high displacement efficiency, and the makers state that the mechanical efficiency is also high. It is suitable for running at high speeds, and can be driven by an electric motor direct coupled. The pump is made in

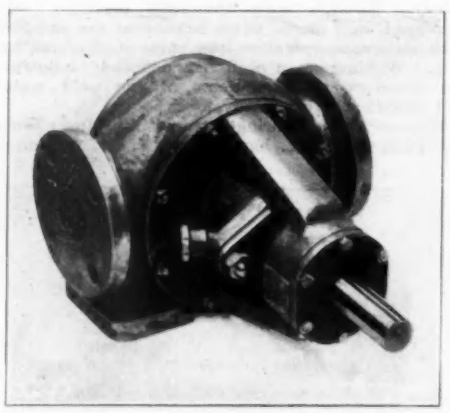


FIG. 85—ROTARY PUMP—THOMPSON

both the vertical and horizontal forms, and is capable of pumping against heads up to 200ft. of water. It is made in a range of sizes, with branches from 1in. to 8in. in diameter. The smallest size, running at 1100 to 1400 r.p.m., delivers 11 gallons per minute, while the largest delivers 655 gallons per minute at 220 to 300 r.p.m. The speed at which the pump is run depends to some extent upon the viscosity of the oil passing through it.

Examples of a variety of sizes and types of pump are to be seen on the stand, and a 4in. vertical spindle type, capable of pumping 40 tons of fuel oil per hour and connected to a 10 H.P., 220-volt D.C. motor, running at 450 r.p.m., made by Laurence Scott and Electromotors Ltd., is arranged to deliver the oil to a tank 25ft. above the floor.

A number of other specialities of the firm are also shown on the stand, and these include welded steel tanks, a lightning hose coupler, and a simple but effective combined petrol filter and water separator.

BERNARD HOLLAND AND CO.

The stand of Bernard Holland and Co., of 17, Victoria-street, Westminster, is noteworthy on account of the variety of its exhibits, which include rotary air compressors and vacuum pumps, and also an oil engine of novel design, made by the Swiss Locomotive Company, of Winterthur, which firm is represented in this country by Bernard Holland and Co. We

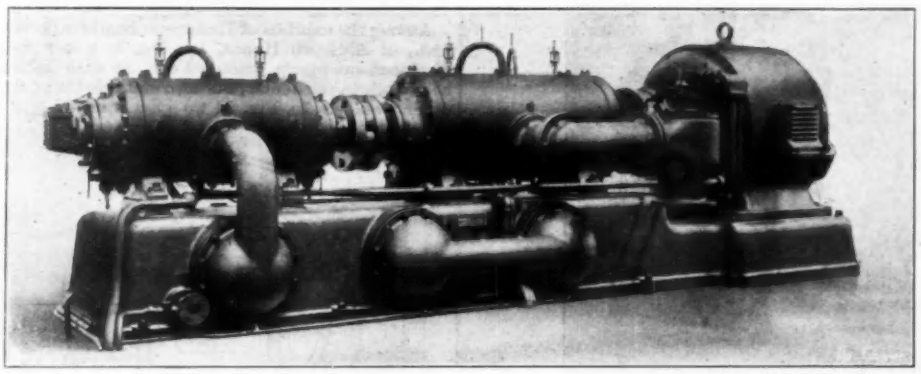


FIG. 86—TWO-STAGE ROTARY COMPRESSOR—HOLLAND

illustrate in Fig. 86 one of the larger exhibits, which is a two-stage electrically driven rotary compressor of the S.L.M. patented radial blade type. It has a designed output of 500 cubic feet of free air per minute delivered at a pressure of 100 lb. per square inch and is coupled direct to a 104 B.H.P. 400 to 410-volt three-phase 50-cycle motor built by the Lancashire Dynamo and Motor Company, Ltd., of Manchester. This type of machine is similar to those supplied by the firm for compressing town's gas, SO_2 gas and oilfield gas. Each of the two compressor units comprises a fixed stator bolted to the foundation plate, in which the rotor furnished with radial blades revolves. The rotor is placed excentrically to its casing and forms a crescent-shaped space between the two parts, which is divided by the blades into cells. During rotation the cells expand from a minimum to a maximum capacity during the suction period and then again decrease to a minimum capacity during the delivery or compression period. A feature of the design is the use of floating rings near either end of the rotor, which revolve with it and take the centrifugal thrust of the blades. This particular design is one which, we are informed, shows very good results in practice, with noticeable freedom from vibration and wear. By means of suitable pipes and stop valves the compressors may be used to perform a dual service of compressing and exhausting, the same machine being operated either as a compressor or as a vacuum pump without having to change its design or to alter the direction of its rotation.

A smaller set which is shown running is a 200 lb. pressure unit driven by a direct-coupled Brown-Boveri motor, the compressor having a designed output of 8 cubic feet of free air per minute.

Our second illustration, Fig. 87, shows a Holland S.L.M. portable air compressor unit with a rated capacity of 120 cubic feet of free air per minute delivered at a working pressure of 100 lb. per square inch. The compressor is of the two-stage water-cooled type and is driven by a four-cylinder petrol engine. The cooling system is of the fan-cooled radiator type, the water first entering the air compressor and then passing to the engine, after which it is returned to the radiator for cooling. In front of the radiator the intermediate cooler for cooling the air between the first and the second stages of compression may be noted. The air suction pipe is furnished with an air filter comprising a container filled with "Raschig" rings, which are kept moist by a fine spray of oil delivered to the container each time the governor closes the inlet thereby allowing the compressor to run idle. The air hose connections, three in number, which can be used in any desired grouping, are provided on each side of the machine and are attached to the air receivers. The two receivers are each provided with a drain cock and a safety valve. Each hose connection is of the fully automatic type, the valve being designed to open when the hose is screwed on and to close as soon as the connection is unscrewed.

We understand that the firm has recently introduced a new air-cooled rotary air compressor plant of the same capacity as that above described, which has been specially designed for work in mines, tunnels, and on railways and tramways, for which an air-cooled machine avoids some of the difficulties often met with when using water-cooled machines. Although one of these new machines could not be exhibited for lack of space, a small air-cooled compressor having a designed output of 88 cubic feet of free air per minute is shown. The S.L.M. totally enclosed high-speed airless-injection marine oil engine exhibited on the stand has a rated output of 100 B.H.P. at 850 r.p.m. and embodies a novel form of oil-operated clutch designed to give full ahead and astern power. We hope to deal with this unit in a later article.

BARR AND STROUD, LTD.

The exhibit of range-finders shown by Barr and Stroud, Ltd., of Glasgow, is closely similar to that which the firm had on view at the last Exhibition and which we dealt with at some length in our issue of September 13th, 1929. From an advantageous posi-

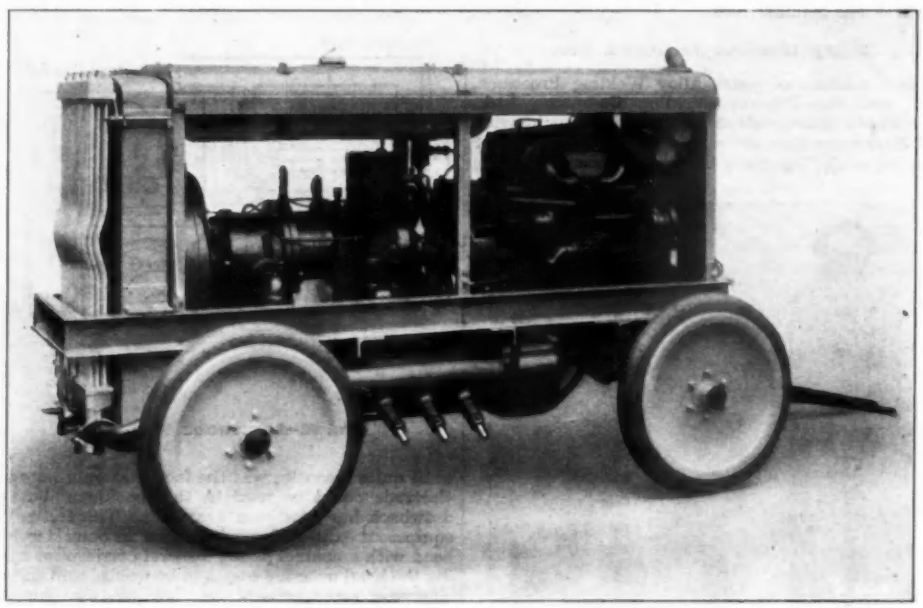


FIG. 87—PORTABLE AIR COMPRESSOR—HOLLAND

tion at one end of the gallery visitors are enabled to examine the ease of operation of the Barr and Stroud range-finder by determining for themselves the length of the main hall. The principle of the range-finder remains unaltered from that worked out in its essentials in the course of three weeks during 1888 by the late Dr. Barr and his colleague, Professor Stroud. In its details, however, it has in the intervening years been greatly improved. Even since the last Exhibition small improvements have been introduced, but they are so slight that for all present purposes the instrument may be considered as completely standardised. The range-finders exhibited are of three patterns. The largest—but by no means the largest made by the firm—is one with a base length of 4ft. 6in. mounted on a pedestal and intended as an aid to the navigation of large merchant ships, cable ships and liners. The design of this pattern is such as to permit the employment of large optical parts possessing great light-gathering power, a point of much importance in misty weather and in other conditions of bad visibility. This instrument at a range of one sea mile has an approximate uncertainty of observation of 5·6 yards. The second pattern is a 1 m. base instrument supported on a deck mounting and intended for use on oil tankers, small cargo and passenger ships and yachts. The third pattern has a base length of 80 cm. and can be arranged either for mounting on the ship's rail or for mounting on harness strapped to the observer. This pattern may alternatively be supported on a portable tripod and is otherwise adapted for surveying or range-finding on land.

An extensive exhibit of binoculars is also to be found on the firm's stand. Most of the glasses shown are of the prismatic type and include provision for the adjustment of the interocular distance and for the separate focussing of the eyepieces. It is of interest to learn that the binoculars, even to the glass of the lenses and prisms, are manufactured entirely by the firm, that they are all light in weight, and that they are sold at a price which is less by a considerable amount than that charged for continental glasses of corresponding quality. A recent pattern of prismatic night binocular is of especial interest. It has a magnification of 7 diameters and weighs only 33 oz. This glass, after exhaustive trials, has been adopted by the Admiralty for general use in the British Navy.

(To be continued.)

SPEAKING on September 16th, Mr. C. T. Cramp, who may be regarded as an authority on the subject, said that it was conceivable that the London Passenger Traffic Bill might not be taken in the present session of Parliament.

The British Association Centenary Meeting.

No. I.

THE general outline of the programme of the Centenary Meeting of the British Association for the Advancement of Science, which is being held this year in London from September 23rd to 30th—somewhat later than usual in order that some part might be taken by the B.A. in the Faraday celebrations—is similar to that of previous years. It may surprise some people to know that the British Association has never previously held a meeting in London, and, according to a statement by the Secretary of the Association, it may not hold another there for another hundred years. The reason given for this is that the major learned societies have their headquarters and hold their meetings in London, and the founders of the British Association, together with those who have since carried on the work, disclaim any intention of intruding upon the ground occupied by these societies. Although the arrangements for the meetings in London this year follow the usual procedure, an endeavour has been made to raise a Special Centenary Fund, which will provide the Association with means for extending its scope. Many have marked their appreciation of the Association's work by contributing to that fund, and it is hoped, when the national position becomes more settled, to make a further attempt in this direction. A sum of £40,000 was aimed at this year.

London necessarily provides far better facilities for holding the many sectional meetings than are sometimes to be found in the provincial towns and cities where the meetings are ordinarily held, and the bulk of the meetings will be held in the many large buildings in the South Kensington area, where exist the Imperial College of Science, the University of London, the Science Museum, and other similar buildings. The Albert Hall is close by, and it was intended that the Presidential Address by General the Right Hon. J. C. Smuts, F.R.S., should be delivered there. However, Albert Hall is fully taken up with the Faraday Centenary Exhibition, which was opened by General Smuts in the afternoon of Wednesday, September 23rd, and the ceremony of inducting the new President, followed by the delivery of his address, took place in the evening at the Central Hall, Westminster, when General Smuts delivered an address, entitled "The Scientific World Picture of To-day."

The Sectional Meetings opened, as usual, on the following morning, and, as in previous years, our main interest lies in Section G (Engineering). At the same time, there will be occasion to refer briefly to some of the other Sections, particularly Section F (Economic Science and Statistics), in which some interesting papers relating to the application of science to industry in various aspects will be given. A special subsection has been added to this section this year, entitled "Department of Industrial Co-operation," the programme of which has been arranged by an organisation known as "Management Research Groups." This section was inaugurated in 1926 by a few people who are interested, both as directors and as citizens, in industrial recovery, and believe that it is possible to make bigger profits and to pay higher wages all round by applying the most recent developments in the technique of management to a variety of enterprises. The main idea underlying the formation of these groups is organised co-operation between a number of businesses in the solution of their common problems of management and administration. Realising that there is a justifiable prejudice against the multiplication of conferences and conventions, which are apt to be theoretical and "end in talk," an endeavour has been made to form an organisation which should enable business men to exchange ideas on their common problems, and to benefit in a practical way from each other's experience with the least possible expenditure of time and effort. This year, at the British Association meetings, there will be discussions on such matters as "The Aims, Methods, and Progress of Research into Management Problems," "The Means of Co-operation between Industry and Educational Institutions in Promoting the Training of Managers," "Patents and the Protection of Scientific Discovery," and "Bridging the Gap Between the Birth of an Idea and its Industrial Application."

The Presidential Address to Section G (Engineering) will be delivered to-day—Friday—at five o'clock by Sir Alfred Ewing, K.C.B., F.R.S. It also constitutes the Bramwell Trust Lecture, established by Sir Frederick Bramwell in 1903, who made provision for the preparation of a lecture "dealing with the whole question of prime movers of 1931, and especially with the then relation between steam engines and internal combustion engines." This address will be reprinted in our next issue.

Very full programmes have been arranged for the various meetings of Section G, and the first paper presented on Thursday, September 24th, was an appropriate one by Sir Robert Hadfield, Bart., F.R.S., entitled "Notes on a Research on Faraday's Steels and Alloys." This is another of those comprehensive and painstaking compilations of a historical character with which Sir Robert's name has been associated on so many occasions.

FARADAY AND STEEL RESEARCH.

For the first time, the "Steel and Alloys" made by Michael Faraday during the period 1819–1824 have now been subjected to complete examination, including chemical analysis, metallographic, physical, mechanical and other tests. Hitherto, the only information available concerning Faraday's metallurgical researches has been that contained in papers which he presented jointly with James Stodart, F.R.S., to the Royal Institution in 1820, and the Royal Society in 1822, but not much definite information from the modern point of view is to be gleaned from those papers, as they contain very little in the way of chemical analysis or quantitative tests. By permission of the managers of the Royal Institution, Sir Robert Hadfield has been able to investigate the nature and properties of seventy-nine specimens of Faraday's steel and alloys by the aid of the resources of a modern research laboratory. From the information thus obtained, which could have been secured by no other means, it is evident that Faraday's work constituted an important and valuable research, specially considering the state of metallurigcal knowledge and practice at the time. In fact, it was not only his first research, but also the first systematic research in the field of steel alloys on a comprehensive scale.

Faraday made and examined alloys of steel with at least sixteen different elements as well as four special compounds, and though the specimens examined by Sir Robert represent only a portion of the total number made by Faraday, it is clear that his work by no means ended in failure, as has been stated by some who were not metallurigsts and were only able to inspect the specimens, if, indeed, they saw them at all. Some of the most interesting alloys made by Faraday, including those containing very high percentages of platinum and rhodium, were not to be found in the small deal box, labelled "Steel and Alloys," in his own handwriting, which lay in the store-room of the Royal Institution for more than a century. A recent most careful search there failed to reveal any trace of these high platinum and rhodium alloys which Faraday described. Neither have the most painstaking inquiries in Sheffield and London brought to light any of the comparatively heavy ingots of Faraday's alloys, weighing 10 lb. to 20 lb. each, which were made to his instructions by the firm of Sandersons, in Sheffield.

All that has survived is the deal box, containing seventy-nine specimens, of which only thirteen weighed 100 grammes (3½ oz.), or over, the heaviest 140·10 grammes (5 oz.), and the other sixty-six averaged only 31 grammes (1·1 oz.) each. The total weight of the seventy-nine specimens was 7 lb. 14 oz. Information given in Stodart and Faraday's papers of 1820 provides some useful clues of a general nature, but there is nothing to indicate the actual composition of the individual specimens. Nevertheless, with so small a total weight of material, with so many alloys of different and quite unknown composition and with the further handicap of having to work with a small portion of each specimen, so that none of these valuable relics might be completely destroyed, Sir Robert has succeeded in determining the composition, nature and properties of the greater portion of them, and from them he has discovered much information useful to-day.

Sir Robert Hadfield not only describes his own research on Faraday's specimens and presents the results obtained, but he also relates the circumstances which led up to Faraday's research, and describes the methods employed by that great experimental philosopher in that, the first, of his important researches. The great influence of wootz, or Indian, steel in the early years of the last century is explained and the relation between James Stodart, the maker of surgical instruments and cutlery, and Michael Faraday, who at that time regarded himself primarily as a chemist is made clear. The primitive state of scientific and metallurgical knowledge in those days is indicated, and the hand-blown "blast-furnace" and crucibles in which Faraday prepared his alloys are described. With these resources Faraday was able to melt pure iron, and to make alloys of platinum and steel. He could, in fact, reach such temperatures as often caused his best crucibles to soften and break down. Sir Robert relates how the long series of small-scale experiments conducted by Faraday himself in the Royal Institution were followed by the manufacture of alloys on a comparatively large scale at Sheffield. Some of the alloys were used to make cutlery, razors, fenders and other commercial articles. Faraday continued his researches for nearly a year after Stodart's death, but then, influenced, no doubt, by the difficulties attending metallurgical operations and want of precise chemical knowledge in those days, the absence of any urgent demand for alloy steels in industry, and the pressing claims of other researches, he did not further pursue metallurgical work. Faraday is, and will always remain, most famous for his electrical and chemical researches, but the facts disclosed, it is believed, for the first time by the present research, entitle him to be regarded as a metallurgical investigator of the highest ability and the pioneer of alloy steels.

We shall deal with other papers in Section G on September 24th in following issues.

THE STUDY OF FLAMES.

On Thursday, September 24th, in an evening discourse, in the Hall of the Royal Geographical Society, Professor W. A. Bone, F.R.S., dealt in detail with the work that is being done at the Imperial College of Science in connection with the photographic analysis of explosion flames. In principle, the method usually employed for the photographic analysis of explosion flames is the same as that originally designed by Mallard and Le Chatelier fifty years ago. It consists of photographing the movements of the flame along a horizontal glass tube on a sensitised plate or film moving vertically at a suitable known velocity, thus obtaining, *inter alia*, a graph compounded of the two velocities, from which that of the flame at any point can be deduced. The experimental method of Mallard and Le Chatelier was developed and improved by the late Professor H. B. Dixon and his collaborators during the 'nineties of last century.

Within recent years the experimental method has been further developed and improved in the laboratories at the Imperial College, South Kensington, chiefly by means of the new high-speed photographic machines designed by Mr. R. P. Fraser, which have so increased its analysing power that it is now possible to photograph and measure movements in explosion flames occurring periodically with frequencies of up to 250,000 per second; and with a new type of camera, embodying the principle of a mirror revolving *in vacuo* at high constant velocity—up to 30,000 r.p.m. —and projecting the image of the explosion flame on to a stationary film, it is hoped soon further to increase the analysing power four or five-fold, so that in the near future it should be possible to photograph and measure periodic flame movements occurring with frequencies of a million per second.

The results so far obtained have already modified and corrected many former ideas concerning the nature of the initial phase of slow uniform flame movement in gaseous explosion and, *inter alia*, disprove the supposed "law of flame speeds." Indeed, it now seems probable that what Mallard and Le Chatelier visualised as flame propagation "by conduction" is an ideal condition perhaps realisable only when a stagnant explosive mixture is ignited without impulse at the centre of a spherical vessel of infinite radius. Important new information has been obtained regarding the influence of "compression" and "shock" waves upon the speeding up of combustion and flame movements during explosions, and it is now proved that its speed can be abruptly raised from a lower to a higher uniform value when a flame is overtaken by a "shock wave" travelling in the same direction. Indeed, it has been shown that in such manner the flame speed can be successively raised "per saltum" many times, and that it may assume any uniform value between the limits of that theoretically corresponding with propagation by conduction, and that due to propagation by "adiabatic compression."

Much new light has been thrown on what may be termed the "pre-detonation" phase of explosion, when the flame is advancing at a speed greater than that of any "shock" wave through the unburnt medium and is therefore overtaking any such shock waves which are ahead of it. Photographs were exhibited showing how "detonation" is ultimately set up when a rapidly moving flame on the verge thereof is just about to overtake a shock wave immediately in front of it. Thereupon an "ignition ahead" of the flame front occurs, and immediately afterwards "detonation" is set up. Indeed, during the "pre-detonation" phase a series of successive such "ignitions ahead" may occur, detonation being set up immediately after the last one. Photographs were also shown analysing the "spin" phenomenon in detonation, which was first observed five years ago in detonation of moist $2CO+O_2$ mixtures by C. Campbell and D. W. Woodhead, working in the late H. B. Dixon's laboratory, and later in the laboratories at South Kensington. It has also been observed in detonations of methane-oxygen, pentane-oxygen, undiluted, and other media, and apparently is caused by the helical rotation of a luminous "head" of detonation in the flame front together with a long luminous "tail" behind it. The pitch L and frequency f of such rotation in detonations of a given medium varies with the internal diameter D of the tube, so that, while the ratio L/D for diameters up to about 1in. is constant and nearly equal to 3·0, the helical velocity of the rotating head of detonation is approximately of the same order, irrespective of the medium or of the tube diameter.

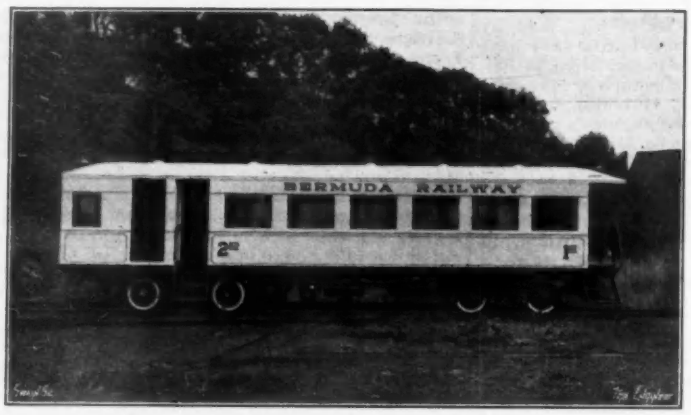
These discoveries have necessitated some revision of the old classic conception of "detonation" and opened up new lines of inquiry concerning it.

Within recent years the photographic method has also been used for the purpose of analysing (i) ignition phenomena, including the "induction period" of explosions; (ii) the influence of moisture upon explosions of carbonic oxide-oxygen mixtures; and (iii) the influence of strong electrical fields upon gaseous explosions, and some results of such analyses were shown by Professor Bone.

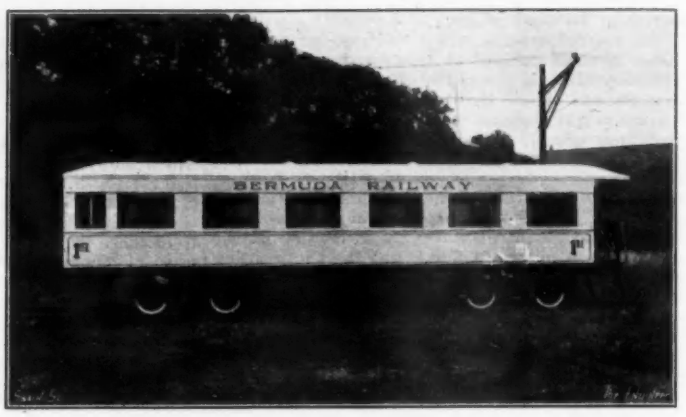
(To be continued.)

BERMUDA RAILWAY—PETROL ENGINE DRIVEN RAIL COACH

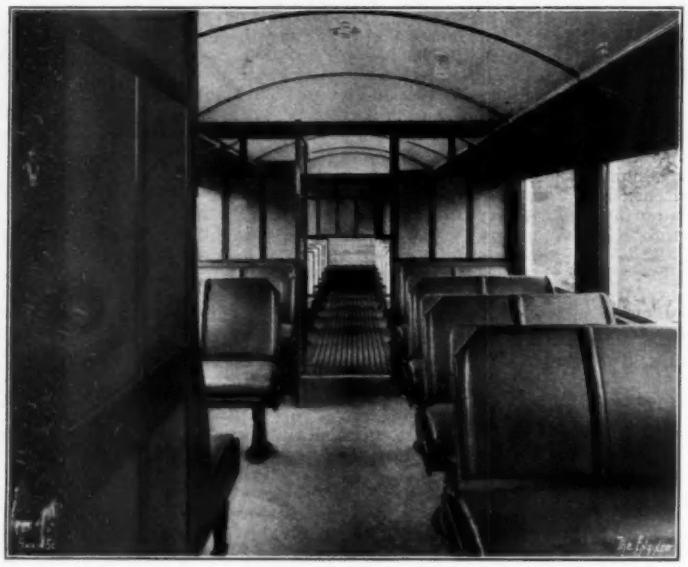
THE DREWRY CAR COMPANY, LTD., LONDON, ENGINEERS



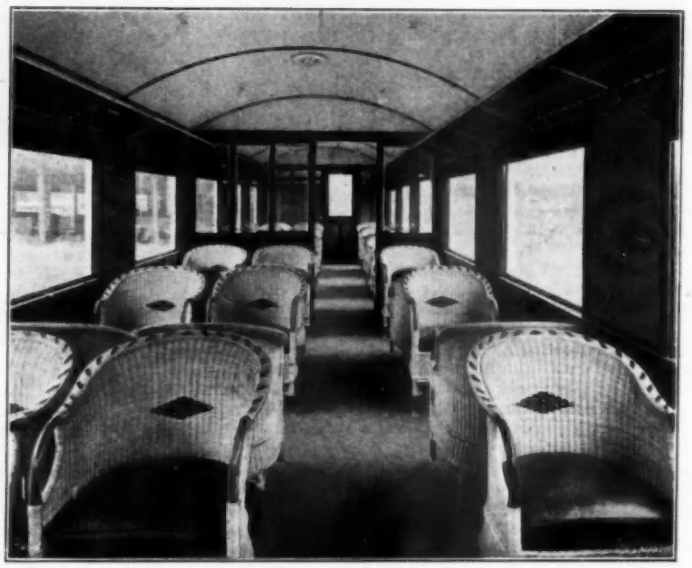
THE POWER COACH



THE TRAILER COACH



INTERIOR OF POWER COACH



INTERIOR OF TRAILER COACH

A Petrol Engine Driven Rail Coach.

No. I.

WE recently took part in a demonstration run of a petrol-driven rail coach for the new Bermuda Railway. This railway, which is now under construction, and will probably be finished by the end of the year, connects up the various islands of which Bermuda is formed. Bermuda is a winter holiday resort for New York. It is formed almost entirely of coral, and has no rivers, and hence no water supply other than that obtainable by catching the rainfall, which is plentiful, on the roofs of the houses. Some years ago this supply was seriously threatened with contamination by the clouds of dust thrown up by motor cars travelling at speed along the dusty roads of the island, and in consequence motor traffic was forbidden, and the only means of conveyance left were bicycles and horse-driven carts. As some more rapid and convenient means of progress seemed to be required, it was decided that a railway should be built, and Balfour, Beatty and Co., Ltd., were appointed the contractors.

This railway connects up Somerset Island, the Main Island, and St. George's Island, having its terminus at the capital, Hamilton, from which the two branches of the line diverge, respectively, to the two smaller islands. At Hamilton the line runs through the streets of the town. When finished, the railway will be 22½ miles long, of which distance 2½ miles are accounted for by bridges and viaducts. It has a maximum gradient of 1 in 50, and the minimum radius of the sharpest curve is 140ft. That part of the line between Hamilton and Somerset Island is already completed.

Owing to the shortage of water, steam traction was out of the question, and petrol-driven coaches were decided upon. The cars are being constructed by the Drewry Car Company, Ltd., of River Plate House, Finsbury-pavement, London, and the trials to which we have referred took place near Preston. They consisted of a run from that station to Longridge, about 7 miles away, upon a single line track used only for the conveyance of goods. The gradients are severe, and the line climbs almost continuously from Preston to Longridge. At no part is it level. Just outside Preston there is an exceptionally short radius curve. The car performed excellently and proved itself steady and comfortable at all speeds on a track that was none too well laid.

The good appearance of the car may be judged from the photographs reproduced on this page, which illustrate the power coach and the trailer coach. The exterior colour is cream picked out by lining. Other engravings show the roomy interior arrangements. The trailer car is fitted up as a first-class saloon of a luxury type, and is capable of seating forty passengers in basket chairs. It is entered from platforms at each end. The power coach has seating accommodation for sixteen first-class and twenty-six second-class passengers, the two compartments being separated by a sliding door. The seats are reversible. At the rear end a platform is arranged which gives access to the first-class compartment, while the second-class compartment is entered by side doors. Both the power and trailer coaches are lit electrically from batteries charged by dynamos driven by the engine.

The coachwork was constructed by Craven's Railway Carriage and Wagon Co., Ltd. The body framing is of teak, while the outer panels are of 16 gauge steel plate, in both the power and trailer coaches. Large windows are provided, and vision is almost equivalent to that in an observation car. The trailer is not provided with any driver's compartment, but there is one at each end of the power coach. It will be seen from the illustration of the latter that the driver's compartment at the leading end is large and is entered from a side door. The appearance of the interior can be seen in another engraving accompanying this article. The raised portion in the middle of the floor space covers the engine, which projects some way above the general floor level of the coach. The cover is utilised as a luggage grid. Beneath the central window a cover hides the radiator. The driver's seat and the control box are to be seen on the

DRIVER'S COMPARTMENT AT LEADING END OF POWER COACH

right. The driving controls are conveniently arranged and consist of three handles, a throttle lever, a gear selector and a gear change lever.

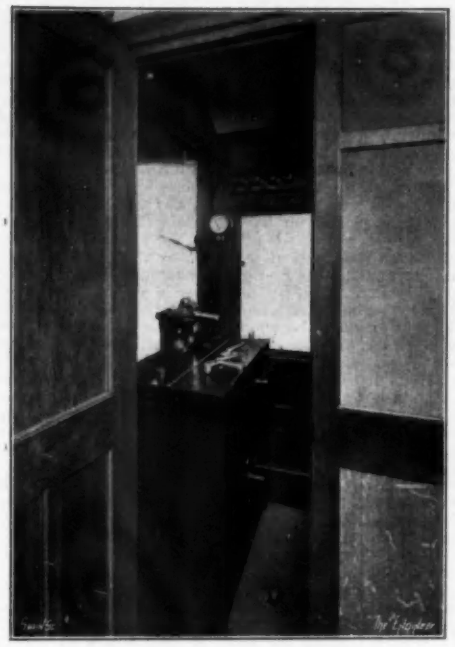
The car is equipped with an automatic gear-changing device, which will be described in our next issue. From the driver's point of view, the operation is very simple. A selector is placed with its pointer against the gear that will next be required, but this gear is not engaged until the change lever is operated. Silent changes are always effected, and any gear may be selected irrespective of that in use at the time. As seen in the engraving, the Westinghouse brake lever stands above the table and is silhouetted against the window. On the table itself there is, on the left, the gear change lever, next the selector handle, and on the right the throttle. The hand brake can also be seen. The connection between the driving table and the gear mechanism is pneumatic, the necessary air to operate the controls being obtained from the Westinghouse brake equipment. Reverse is obtained independently of the main gear-box, so that the whole range of five speeds is available in both directions. To put reverse in gear, the handle must be lifted from the selector and placed upon the reversing spindle, and in order to render it impossible to engage reverse when the engine is in gear, the handle is locked in place on the selector spindle in any position other than neutral, thus ensuring that the car shall first be stopped before reverse can be engaged. The position of the reverse key is best seen in the photograph reproduced with this article illustrating the driver's compartment at the rear end of the power coach. It is visible on the further side of the table. This compartment occupies a length equivalent to one window space, and extends less than half-way across the coach. In spite of these small dimensions, however, there is plenty of room inside for the driver. The controls can clearly be seen in the engraving.

The main dimensions of the power coach are as follows :

	Ft.	in.
Length over headstocks	42	0
Width over pillars	9	0
Overall height from rail to top of roof	11	6
Distance between centres of bogies	25	0
Wheelbase of power bogie	6	6
Wheelbase of trailer bogie	5	6
Diameter of wheels	2	6
Gauge	4	8½
Weight	About 20 tons	

The dimensions of the trailer car are the same, except that the weight is only 14 tons.

The power unit is illustrated in the drawing on this page. The engine, transmission, and all auxiliaries are mounted upon it. In consequence, a straight line transmission from the engine to the final drive is obtained, and the maximum possible weight is concentrated on the driving wheels for adhesion. This construction also has the advantage that when overhauls and repairs are necessary, the whole power unit can be withdrawn from beneath the coach, and a spare unit substituted, so that the car does not need to be withdrawn from service. In the drawing the bogie is shown equipped with coupling-rods, but on the occasion of our visit such rods were not in use, although arrangements were available for fitting them should they be required. The final drive from the bevel shaft to the wheels is through chains. The transmission from the engine to the wheels is through a Wilson-Drewry epicyclic pre-selective gear-box, giving five speeds. This gear-box will be described more fully in our next issue. Its position can be seen on the drawing at the rear end of the bogie. Engagement of the gears is entirely silent, and, indeed, except for the first two gear changes, when starting up, we found it very difficult to determine the moment at which the change from one gear to another was made.

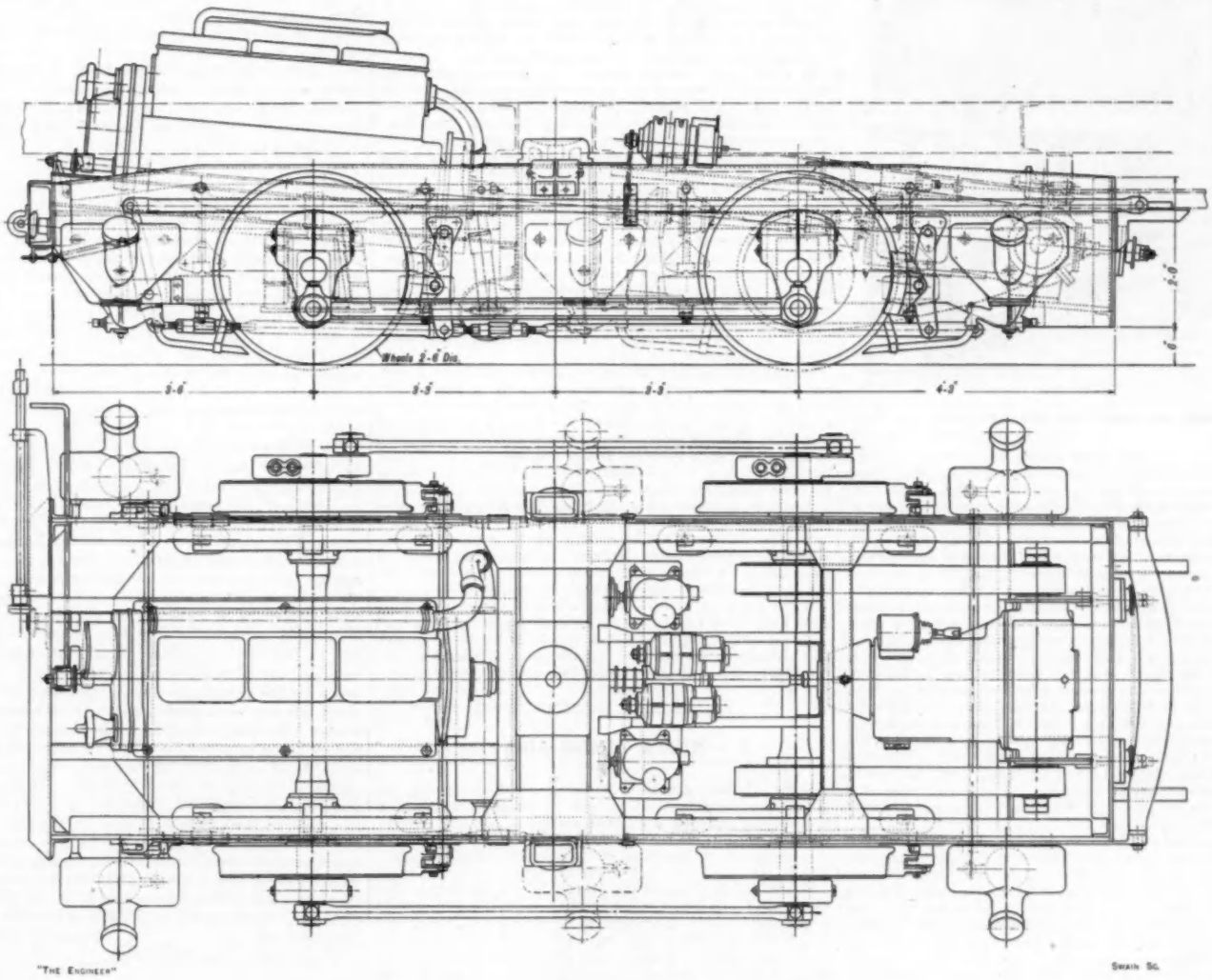


DRIVER'S COMPARTMENT AT REAR END OF POWER COACH

The power bogie itself has plate side frames and channel end members. It is fitted with a spherical centre pivot. Besides the gear-box and the final bevel drive and various auxiliary units, there is mounted upon the bogie the main engine. This engine uses petrol, and was constructed by the Parsons Oil Engine Company, Ltd., of Southampton. It has six cylinders of 4¾in. bore by a 6in. stroke, and develops 115 H.P. at a normal working speed of 1650 r.p.m. The cylinders are cast in pairs. The engine is started by an electric motor from controls in the driver's compartments. The motor acts through an automatically disengaging gear, similar to that used on many motor cars, on to the fly-wheel of the engine. The compressors for the Westinghouse brake equipment are mounted upon the power bogie and are driven directly by the engine. Other features to be seen in the drawing are the two dynamos for charging the lighting batteries and the pneumatic cylinders operating the change gear.

On the occasion of the demonstration run the power car travelled out from Preston Station with a party on board greater than the seating capacity of the vehicle. It was driven by a mechanic who had had previously only experience of handling a small motor car, and had only been in charge of the rail coach for two or three days. Yet in that short time he had entirely mastered the simple controls. The run was entirely satisfactory. The return journey was made with the trailer coach connected up.

(To be continued.)



PLAN AND ELEVATION OF THE POWER BOGIE

STEEL CASTING PRODUCTION IN THE UNITED STATES.

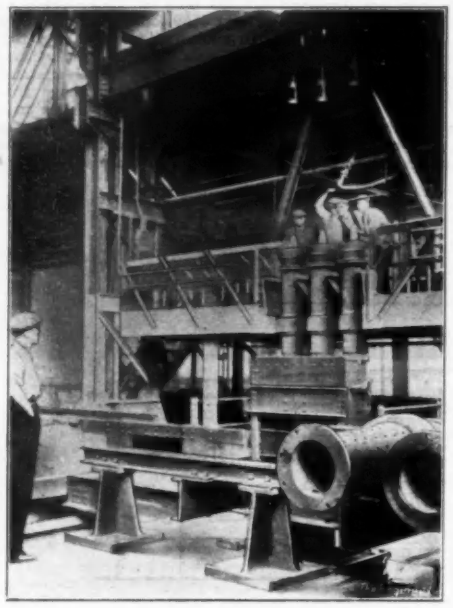
THE production of steel castings in the United States during the year 1930 amounted to 1,236,720 tons, of which 877,490 tons were open-hearth steel, 341,803 tons electric steel, 16,656 tons converter steel, and 773 tons crucible steel. In percentage of total output, open-hearth castings represented 70·95 per cent.; electric steel, 27·64 per cent.; converter, 1·35 per cent.; and crucible, 0·06 per cent. Until about 1912 open-hearth castings represented 90 per cent. or more, while electric steel had not then reached 1 per cent. Converter steel rose steadily to a maximum of 11·39 per cent. in 1918, since when it has steadily declined. Crucible steel had its maximum of 3·21 per cent. as far back as 1898; in 1908 it reached 2·39 per cent., but has since declined to an almost negligible proportion. Alloy steels amounted to 141,264 tons as against 216,070 tons in 1929. Of these alloy steel castings, 68,589 tons, or 48·55 per cent., were made by the electric process; 50,352 tons or 35·64 per cent. by the acid open-hearth; 17,208 tons or 12·18 per cent. by the basic open-hearth; and 5109 tons or 3·62 per cent. by the converter process. Crucible steel formed a negligible percentage with a total of 6 tons. However, alloy steel castings are often required in relatively small amounts, and as the open-hearth foundry furnaces range from 20 to 30 tons charge capacity, the small orders must depend mainly on the electric furnaces, which average charges of 4 or 5 tons. Increasing demand for alloy steel castings has been reflected therefore in increased numbers of electric furnaces. Most of these are arc furnaces, but the induction type has also developed to the commercial stage. As to producing capacity, this is given as 811,300 tons for basic open-hearth, 691,290 tons for acid open-hearth, and 605,490 tons for electric steel, or a probable total of about 2,333,000 tons, as compared with the actual 1930 output of 1,236,720 tons.

A New Sand Spun Pipe Plant.

ON Wednesday and Thursday of last week a new sand spun pipe plant erected at the works of the Staveley Coal and Iron Company, Ltd., was officially opened, many people being invited to the ceremony. On this page and on page 324 we reproduce a number of photographs illustrating the new plant.

At present the plant is designed to produce 80,000 tons per annum of sand spun iron pipes of sizes from 4in. to 12in. in diameter, the length being in each case 16ft. As normally produced, the pipes have an integral spigot bead, but beadless pipes and turned and bored pipes can also be produced in the same lengths and diameters. The process of manufacture consists of pouring the molten cast iron into a rapidly spinning sand mould. The molten metal is forced centrifugally to the outside of the mould forming a cylinder of metal of even thickness and grain over the whole surface, and thus producing a pipe.

Beginning, as seems rational, at that part of the cycle of operations where the mould is formed, it will be seen from the engravings that the moulding boxes consist of circular flasks, having small vent holes drilled at intervals around their circumferences. The thickness of metal is increased towards each end, so that the flasks can be rolled along rails without fear of becoming "de-railed." The flasks and rails can be clearly seen in the engraving showing a general view of the shop on page 324. Two sets of rails are to be seen. The flasks on the left are coming away from the spinning machines to be stripped, while those on the right are passing to the jolting stations to be packed with sand. They are moved along the rails by man-power or caused to roll by sloping the rails. They are packed with sand three at a time at each jolting station, to which sand is delivered through two flexible pipes from rotary-bottomed storage bunkers above. As three flasks roll opposite to the station, they are picked up upon a hydraulically operated tilting table, and raised to the vertical position. A gallery is arranged here of a suitable height to make packing of the flasks from the



ONE OF THE JOLTING STATIONS

top convenient. The photograph reproduced on this page shows three flasks raised to the vertical position and the moulders at work in the gallery packing them with sand. The edge of the tilting table which forms the bottom of the mould when the flasks are in the vertical position is furnished with spigots to centre the flasks and depressions to centre the patterns when they are in position. The patterns are raised and lowered from above by electric winches capable of lifting 60 tons. When in position, a hopper, which is provided with lugs to centre the pattern in the flask at that end, is placed on the top, and when filled with sand each flask is given approximately 100 jolts. The sand hoppers are then removed, a plate is placed over the end of the flask, and the patterns are withdrawn. In order to relieve the electric winch of part of the load of withdrawal, it is arranged that the two outer patterns shall be picked up first and "started," the centre pattern being "started" when the others have been lifted a few inches. The patterns having been withdrawn, a specially shaped hopper is placed over the flask, and the mould given a flush of liquid blacking. The hopper for this purpose is designed to deliver the blacking as a cylindrical curtain down the mould.

The tilting table is then lowered again to the horizontal position and the flasks are carried to the drying bench, where the moulds are skin dried by means of high-velocity gas jets fed with coke oven gas from the Devonshire works of the company. When the drying operation has been completed, the flasks are lifted, two at a time, by automatic lifting arms on the crane, and placed on rails next to the spinning machines.

There are seven of these machines, each capable of rotating a flask at a speed great enough to subject the metal to a centrifugal force equal to at least seventy-five times gravity. Each consists of a box framework, holding four rollers, two of which are driven and two idle. A safety hood operated hydraulically can be lowered over the flask when it is in place. In the photograph reproduced on page 324, the hood is shown in the raised position. The operation of raising the hood automatically discharges the flask that has just been filled on to rails at the side and admits the next ready for filling.

Molten metal is obtained from cupolas conveniently placed near the spinning machines and is carried in a large ladle by a travelling crane to small ladles situated at the pouring end of each machine. Each small ladle is supported upon a travelling carriage, which, when the ladle is being filled, stands upon the table of a weighing machine. A predetermined weight of metal, suitable to the size of pipe being cast, is poured into the ladle, the amount delivered being registered upon the large, easily read scale of the weighing machine. When filled the small ladle is tilted by a hydraulic ram projecting through the weighing table, and pours its contents into the rapidly revolving mould. The movements of the spinning machine are controlled from the end remote from the pouring end, the operation being aided by two lamps, a red one, which glows when the spinning flask is up to speed, and a yellow one, which indicates that pouring has begun.

Each flask is spun sufficiently long for the metal to set before being transferred to the rails at the side. From this point it is picked up by the crane and carried to the cooling rails, where it is left until the metal is cool. The flasks then pass, two at a time, into a covered compartment to undergo the first of the two operations necessary for stripping. This compartment is visible on the left of the engraving of the general view of the shop on page 324. Tubes of about 1in. diameter, through which compressed air is blown, are forced into the sand between the flask and the casting. In this way a longitudinal strip of sand is removed. The flasks pass automatically out of this compartment and a hydraulic ram operates upon the end of each of the castings and forces it out of its flask on to an electric travelling truck waiting to receive it. As soon as the pipes are clear the table upon which the flasks are resting is tilted, and the sand, dried by the heat of the metal, runs out and falls through a grating to the basement of the building for reconditioning. The cast pipes are carried away on the truck and deposited on rails for distribution to the grinding and testing stations, while the flasks pass back to the jolting stations to begin the cycle again.

The cast pipes are first examined for flaws, and are then conveyed to the grinding stations, where they are supported upon rollers and made to revolve. The grinding wheels are mounted upon the ends of long shafts driven by electric motors, which are themselves supported upon small travelling cranes. The length of the shaft is sufficient to allow the grinding wheel to pass about half-way along the bore of the pipe, and each pipe is ground from both ends. Arrangements are made for removing the dust at the same time.

From the grinding station the pipes pass *viâ* a special lathe, where they can be bored and turned, if that is required, to the testing department, where they are first weighed and then tested hydraulically. At the same time an examination is conducted for any defects. Passing from the testing shop to a department in which they are dipped in bitumen or tar, they are finally delivered into the open air beneath a crane ready for loading directly into trucks for transport to their destinations.

It will be appreciated that if the operations described above are to be carried out as expeditiously as the lay-out of the plant will permit, the sand-handling plant must also be well designed. We have seen that the used sand passes through a grating into the basement. There it is picked up by a conveyor and carried to a large cooling drum. Two elevators collect it as it emerges from the drum, and carry it to a "Hummer" vibrating screen, where any lumps, pieces of metal, &c., are separated out and rejected. The remainder passes into a storage bin. The sand is prepared for use in batches. From the storage bin it goes to a container, which measures out the correct quantity and 5 per cent. of new sand is added. After passing through a rotary mixer, where clay wash is added to restore the bond, the sand is carried to a mill which further increases its strength. From this point it is distributed by conveyors to the various rotary-bottomed bunkers, situated above the jolting stations.

In order to produce the internal contours of the socket end of the pipe, a core made of oil sand has to be inserted into the end of each mould. These cores are made on a couple of squeeze jolters, and the sand for them is prepared in mixers situated above the machines and delivered from overhead hoppers through flexible piping. The cores are baked in ovens conveniently situated near the core-making machines, blacked, and delivered to the spinners where they are inserted in the flasks just before they enter the spinning machines.

Nearly all the driving machinery is situated in the basement, which also houses the machinery for balancing the flasks. As these flasks are rotated at a very high speed, it is essential that they shall be properly balanced.

After the large party visiting the works of the Staveley Coal and Iron Company, Ltd., had inspected the new plant, they were entertained to luncheon by the company and subsequently had the opportunity to make a tour round the chemical plant in the Devonshire Works.

SIXTY YEARS AGO.

WE had been accused, it seems, of discouraging the progress of aeronautical science by refusing to publish the ideas of inventors of flying machines. In our issue of September 29th, 1871, we sought to defend our policy in this respect by inserting a "typical communication" which we had received from a correspondent, Major J. Scott Phillips, late of the Bengal Royal Artillery. Our correspondent's letter, we suggested, would be pronounced a curiosity in the literature of mechanical science, and would afford an excellent explanation of our reasons for declining to insert descriptions of machinery intended to effect aerial navigation. Major Phillips, we added, was quite as sound in his views as the great majority of those inventors of flying machines who favoured us with their communications. Nevertheless, reading Major Phillips' description in the light of present-day knowledge, we can find a good deal in it to admire. Verbose it is to the point of confusion and weariness, but underlying it there is a good substratum of sound science. It contains, for example, a definite indication of the fact that Major Phillips had grasped the truth that the lift developed by an advancing inclined plane is derived at least as much from the vacuum over its upper surface as from the pressure below it. He proposed to take advantage of this phenomenon in a very original manner. His machine was to consist of a leading and a trailing plane. Between the two he proposed to insert a pair of large wheels, extending half above and half below the level of the planes. On the ground the machine would rest on these wheels, and on a pair of skids extending from the trailing plane. The wheels were, however, to be something more than the equivalent of the landing wheels of a modern aeroplane. They were also to serve as the propelling organs for the machine when it was in the air. To that end they were to be fitted with blades or paddles. The ingenuity of the idea resides in the fact that no feathering gear for the blades was to be provided. The blades passing through the pressure region below the planes were to provide the propulsive force. The reduction of pressure above the wings was to be relied upon to produce an effect equivalent to that obtained by feathering the blades. The communication is also remarkable when viewed with proper respect to its date for its insistence upon the necessity for separating the sustaining organs from the propulsive organs, a principle which the majority of contemporary inventors clinging to the example of the birds had not yet grasped. As for the propelling power, Major Phillips insisted that a reciprocating engine was useless, and maintained that the only suitable form was a rotary steam engine. He gave a description of an improved form of Hero's steam turbine, his "improvement" consisting of discharging the steam, not into the air, but through a surrounding rim pierced with a large number of exit passages. Late though it may be, we desire to express a measure of admiration for the views of one whom sixty years ago we held to ridicule.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

RAILWAY IMPROVEMENTS.

SIR,—*Apropos* of the correspondence on "Railway Improvements," by Mr. C. T. Gardner, in the issue of September 18th of THE ENGINEER, permit me to point out a few other deficiencies where improvements for the convenience of travellers can be effected.

(1) The inadequate display of the names of stations, particularly at night-time. May I suggest that these names be displayed in a similar manner as adopted at the stations of the Underground Railways, instead of using those small-type, blue transparent labels on lamps, which, themselves, not infrequently shed but little light, and which are usually above or beyond the normal range of view?

(2) The availability, on Sundays, of suitable refreshments at the larger railway stations is greatly to be desired. At the majority of stations not even a fountain, or tap, labelled "Drinking Water"—and supplying it—is to be seen on any platform!

(3) A necessary (?) evil is the incessant inspection of tickets during long journeys and at night-time. This is carried out not only by different officials at almost every inspection, but also, in some instances, by such in plain clothes, who do not even display a badge of office.

(4) An alteration in the starting times and routes of Sunday excursion trains might be considered from the following point of view. On the longer journeys these trains leave their respective termini at such an hour that, on arriving at their destinations, the best part of the day has passed. Not only that, but the routes followed invariably seem to be along lines which are undergoing repairs, thus involving many stops and delays, and curtailing the passengers' few precious hours at their destinations.

(5) Another item in which an improvement might be considered is that of disposing of heavy luggage without interfering with the travelling public. The system adopted in Germany, for instance, is, briefly, as follows: The passenger arrives at the station, obtains his ticket and then delivers his trunk, for example, at the luggage booking-office, in return for which he is issued a receipt. At the luggage booking-office of his destination he can reclaim his trunk in exchange for the receipt. This apart from sending luggage in advance. In the meantime, his trunk is labelled numerically and is conveyed to the luggage van of the train by routes—lifts, underground passages and luggage platforms—which are separate from those taken by the passengers to and from their trains, so that these are not obstructed by trains of clanging luggage trucks. At many stations these luggage platforms are narrow platforms which serve as foundations for the supports of arched roofings as well; at others they are specially constructed for the purpose. If space does not permit then tunnels are constructed, which terminate at the ends of the main platforms, where lifts for raising and lowering the luggage trucks are provided. No unauthorised person may enter the luggage vans of trains. As there invariably is a post-office attached to each station, there are, again, separate routes from the office to each platform, which enable a quick and efficient disposal of postal matter.

JOHN J. C. BERKELEY.

Whitley Bay, September 20th.

DURING the eight weeks of the summer train services that the "Flying Scotsman" has been making its world's record non-stop run between King's Cross and Edinburgh eight engines of the "Pacific" type have been engaged in the work, and have covered an aggregate of 37,728 miles. The service has had eighteen drivers, and punctuality has been maintained throughout.

Railway and Road Matters.

BECAUSE it is only of 15in. gauge, the Romney, Hythe and Dymchurch Railway is of exceptional interest. It is therefore a pleasure to hear that its August Bank Holiday traffic was 25 per cent. greater than a year ago.

AT the end of the thirty-seventh week of the year, the traffic receipts on the London, Midland and Scottish were down by £4,158,000, when compared with the corresponding period of 1930; on the London and North-Eastern by £3,830,000; by £2,139,000 on the Great Western; and £845,000 on the Southern.

OF the 4853 accidents at road level crossings reported last year to the Interstate Commerce Commission of the United States, 1276, resulting in the deaths of 248 persons and injury to 1771, were caused by motor vehicles and motor cycles crashing into the sides of passing trains. There were 1130 cases of motor cars doing this, which led to 214 deaths.

THE Harwich and Zeebrugge train ferry is receiving a splendid testimonial just now in the transit of 1382 tons of electrical equipment, without any transhipment, from Manchester to Budapest, a distance of 1200 miles. The wagons conveying the consignment are not those belonging to the Train Ferry Company, but the trolley wagons of the London and North-Eastern Railway.

ACCORDING to Colonel Mount's annual report on the railway accidents of last year, it appears that there were 5520 failures of couplings in goods trains and 1156 in passenger trains. Of the former, 10·0 per cent. were due to uncoupling, 57·6 per cent. to the pulling-out or breakage of drawbars or hooks, 29·9 per cent. to the breakage of coupling links, and 2·5 per cent. to the breakage of screw shackles. The corresponding proportions of the 1156 passenger stock failures were 7·9, 48·4, 26·1, and 17·6 per cent.

IN accordance with the practice begun after the Charfield disaster of October, 1928, the Railway Returns now give particulars as to the progress of eliminating the use of gas for the illumination of carriages. At the end of 1930, apart from electrically operated stock, all of which is lighted by electricity, the percentage of passenger-carrying vehicles lighted by gas had decreased from 48 at the end of 1929 to 42½. During the same period the proportion of non-electric passenger stock lighted by electricity rose from 51½ to 57 per cent.

THE celebrations in connection with the Illumination Congress have led to the *Railway Newsletter* for September giving some particulars of the flood-lighting of marshalling yards, of which fifty schemes have been, or are about to be, installed. The proved advantages over point, or local, lighting are that the first and annual costs are considerably less, the lighting points are fewer and ground obstructions are reduced. It was first introduced into this country by the Great Western in 1926, and that company has since installed nineteen systems, using 256 projectors, and seven schemes now under consideration will employ 146 projectors.

ON February 20th last, under circumstances recently reported upon by Lieut.-Colonel Woodhouse, a motor van stood at the gates of a public road level crossing between Pencoed and Bridgend Stations on the South Wales main line of the Great Western. The crossing is worked by a gate keeper, who is provided with distant signals, but there is no interlocking between the gates and the signals, and there are no stop signals at the crossing. Just previously, a train had passed and the gateman had afterwards put the signals to "clear." When the occupant of the motor van was ready to cross, he asked for the gates to be opened, and that was done, but the signals were not put on. At that time another man got into the van, and the two were engaged in conversation for some moments. Eventually, the van started, but came to rest on the crossing, and, whilst there, was run into by an express passenger train, and both men in the van were killed. It is admitted that the road traffic over this crossing is more like that of an occupation crossing, but the onus of looking out for trains at the latter lies definitely with the road user, whereas, at a crossing in charge of a railway servant, the road user is entitled to assume that it is safe for him to cross the line when the gates are opened for him. The provision of stop signals, interlocked with the gates, and the distants to be carried to the regulation distance in the rear, are therefore recommended.

AS many readers of THE ENGINEER may be reluctant to wait for another twelve months for our "Sixty Years Ago" paragraph for that date to relate the sequel to the agitation of September, 1871, related on page 294 of our issue of September 18th, for a wholesale amalgamation of British railways, we will now give the conclusion of that story. The two principal amalgamations then proposed were (1) the London and North-Western and the Lancashire and Yorkshire, and (2) the Midland and the Glasgow and South-Western—the latter was mainly in anticipation of the Midland reaching Carlisle by the Settle and Carlisle line. There was also a Bill for confirming the Quadruple Agreement between the Great Western, Bristol and Exeter, the South Devon, and the London and South-Western. As a result, a Joint Committee of both Houses of Parliament was appointed on February 22nd, 1872, to inquire into and report on the subject of the Amalgamation of Railway Companies. The chairman was Mr. Chichester Fortescue, and the report, which is undated, was approved by the Committee on August 2nd, 1872, and was evidently presented on that date, as it bears the intimation, "Ordered, by the House of Commons, to be printed, August 2nd, 1872." We give these dates in order to show the expedition that was possible in those days. The conclusions and recommendations fill 3½ pages, so it must suffice to say that they open with the remark that past amalgamations had not brought the evils which were anticipated; competition between railways existed only to a limited extent and could not be maintained by legislation; and combination between railway companies was increasing, and was likely to increase, whether by amalgamation or otherwise. Strange to relate, neither of the amalgamations took place, nor was the Quadruple Agreement proceeded with; what is more, nothing was done to assist or restrain general amalgamations or agreements until the Railways Act, 1921.

Notes and Memoranda.

IT is proposed to dam the Tresillian River in Cornwall for the purpose of utilising tidal energy.

AN aeroplane without a tail is said to be arousing keen interest among German flying enthusiasts. It has been constructed to the designs of Captain Koehl, the flying companion of Major Fitzmaurice, who flew the Atlantic. The machine has wings with a span of 36ft., and is equipped with a 20 H.P. Bristol Cherub engine, giving it a maximum speed of 96 miles an hour and a cruising speed of 87. It costs about £350 to build and is fitted with special brakes, which enable it to land in a restricted space.

A NEW type of mechanical totalisator has been introduced by the L. M. Ericsson Telephone Company. Beyond the action of pressing a key on the ticket-issuing machine when the bet is made, no manual work has to be performed, and the totalisator registers all bets, simultaneously giving the increasing total on each horse running, as the bets are accepted, and a ticket cannot be issued until the final bet has been recorded on the totalising equipment. The equipment has been approved by the British Race Course Betting Control Board, and consists primarily of standard relays and rotary line switches similar to those used in automatic telephone exchanges in England.

FROM the Italian vessel "Titano," in the sea at Santa Margherita, near Genoa, immersion tests were recently made with a new diving equipment designed by Signor Galeazza. The apparatus enabled divers to descend rapidly and without the slightest discomfort, to a depth of 100 fathoms. This new apparatus, which consists of a simple metallic shell 1¼in. thick, is cylindrical in form and is topped by a sphere. The five divers who executed the tests were surprised above all at the visibility secured; they were able to read the instruments inside the apparatus at a depth of 100 fathoms without artificial light. The visibility through the windows of the shell has, it is said, exceeded all expectations.

IN his presidential address at the annual conference of the National Smoke Abatement Society at Liverpool, Dr. H. A. Voeux described a method of lighting a fire from the top instead of from the bottom. A good body of fresh coal should be placed on the bars, he explained, then a layer of paper and next the kindling wood, which, if properly dry, would give off sufficient heat to drive the gas out of the coal. This would burn as it passed through the wood and give off little or no smoke, and with the gases the tar and other hydrocarbons would be consumed. When they were burned, he went on to explain, a smokeless solid fuel would be left which would burn without attention for from three to five hours. This method would result in a saving of coal, absence of smoke, and a bright, hot fire from the moment that the wood ignited.

Two of the largest condensers ever made in this country have just been delivered to the new electric power station of the London Power Company at Battersea. When installed they will be coupled to form one unit, the largest of its kind in Great Britain, with a total cooling surface of 60,000 square feet. Each of these condensers has a steam capacity of 185,000 lb. per hour, and will maintain a vacuum of 29in. Each has a tube surface of 30,000 square feet, the tubes passing about 3,000,000 gallons of water per hour. The brass tube plates, 1¼in. thick and having each a superficial area of 135 square feet, were made specially for the constructors at the Birmingham works of I.C.I. Metals, Ltd. The condenser shells are manufactured from ⅝in. mild steel plates, which are riveted and electrically welded together. Too large to be sent by rail, the condensers have had to be transported to London by sea and road from the works of the makers, Richardsons, Westgarth and Co., Ltd., of Hartlepool.

THE world's tallest structure—the Empire State Building in New York City, opened last May—is 1252ft. from the street level to the tip of the mooring mast at its top. When it is fully occupied, it will be necessary each working day to transport vertically 85,000 tenants and visitors. All lifts were designed and constructed by the Otis Elevator Company, of New York. Fifty-eight signal control lifts with automatic starting, stopping, levelling, and door opening and closing devices, are provided to handle the bulk of the work. Nine additional lifts are installed for freight and passenger service for use in the upper seven storeys and the tower. Eighteen of the express lifts operate at a speed of 1200ft. per minute. They can run from the street level to the 80th floor in less than a minute. To interconnect all the electrical circuits required by the lifts in the building, nearly 8,000,000ft. of rubber-covered wire were necessary. In addition, there are 36 miles of conduit. The length of the hoisting ropes, compensating ropes and governor ropes exceeds 120 miles, and there are nearly 7 miles of lift shafts in the building. The entire lift installation cost about £800,000.

THE former South African Union Astronomer, Dr. R. T. A. Innes, has devised a system of stereoscopic projection for cinemas, whereby it will be possible to see figures and scenes in relief as in Nature. This problem, states *The Times*, has been before the scientific world almost since the invention of the cinematograph, but hitherto efforts to solve it have been based upon the method of projection. Dr. Innes says his invention, for which world-wide patent protection has been secured, is founded on a special optical appliance to be fitted near the screen. Strictly private experiments have been carried on in Johannesburg for the past six months, and have resulted in the adaptation of fairly rough models used at the outset, and improvised by leading photographic firms to the needs of commercial exploitation. The final form in which the invention will be exploited has not been determined. An important feature of the innovation is the fact that changes in the methods of taking pictures will not be necessary. The origin of Dr. Innes' discovery was due to an accident. While visiting a *café* bioscope some time ago he noticed an optical effect on a sheet of glass on one of the walls, giving an extremely lifelike stereoscopic image. He immediately grasped the possibilities, and was able to secure similar effects while using an ordinary home cinema projector.

Miscellanea.

THE College of Aeronautical Engineering, which will start its first term shortly, will be the first of its kind in the world—a college devoted to the training of young people for the ground staffs and administrative posts in aviation. It will have class-rooms and workshops at Chelsea and an aerodrome and machines at Brooklands.

IN order to assist the development of the German petroleum industry, the Reichsbahn (German State Railway Company) has reduced its transport rates for German petroleum still further by 36 per cent. The railway tariff for petroleum will thus have been reduced in all by 79 per cent. This new exceptional tariff has been put in force with effect as from September 7th.

STEEL framings for two and three-storey buildings are being produced in Germany by the Stahlbau Düsseldorf. The frames are fully fabricated in the factory by either welding or riveting, so that only the assembly work is necessary at the site. It is stated that the steel skeleton for a three-storey building may be set up in two or three days, and that costs are reduced from 8 to 10 per cent.

AS a result of a representative meeting of mining engineers practising in Southern Rhodesia, held at Salisbury early in August, it was decided to form a local association on the lines of the Institution of Mining and Metallurgy. The initiative was taken by Mr. Digby Burnett. Anyone concerned should communicate with the Secretary, Box 405, Salisbury, S.A., giving particulars of their local addresses.

THE German State Railways have announced a reduction of 25 per cent. in fares for trade buyers travelling to the British Industries Fair in London and Birmingham next February. Leading Swedish and Finnish shipping companies have also announced reduced fares. The British Foreign Office has again agreed to grant free visas to trade buyers coming to Britain for the Fair, and arrangements are being made by the Department of Overseas Trade to make all travel concessions widely known.

THE recent feat of an Italian light monoplane which flew from Milan to Croydon in just over five hours is eclipsed by the performance of Lieutenant Byas, R.N., who, in his Pobjoy-engined Comper Swift flew from Heston to Johannesburg, a distance of 8000 miles, in ten days. His actual flying time was seventy-five hours and his petrol consumption worked out at the low figure of 4½ gallons per hour, or rather less than 30 miles to the gallon. This British machine with folded wings can be stored in any garage lock-up. It sells at £550.

AN international conference of coalowners will be held in London on Wednesday of next week to consider the general position of the coal export trade of Europe and how it affects the various coal-producing countries. The initiative in convening the conference has been taken by the British colliery owners, and it is regarded as an important move towards a general understanding in the coal trade of all countries. Invitations to the conference have been accepted by the colliery owners of France, Belgium, Holland, Germany, Poland and Czecho-Slovakia.

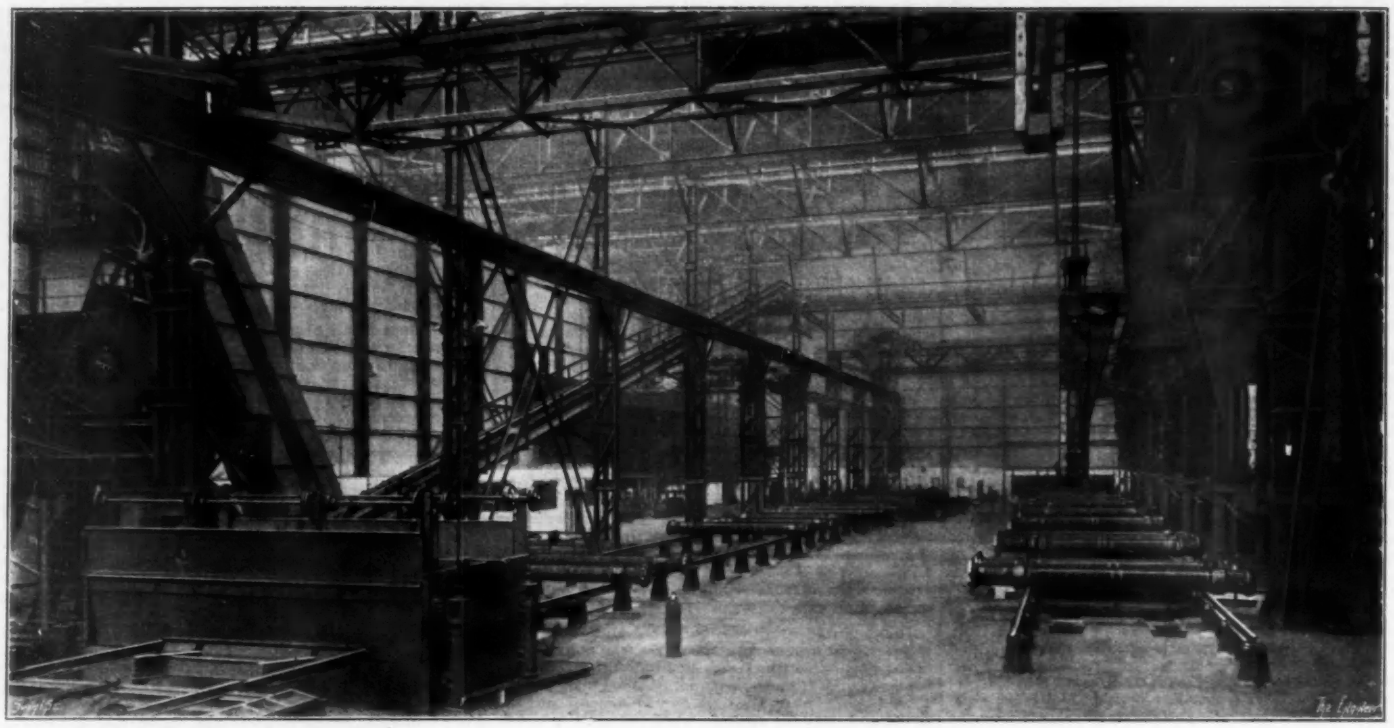
THE Council of the Institute of Marine Engineers desires to remind young engineers and apprentices of the annual examination for student graduateship and the accompanying diploma, open to graduates or others not yet associated with the Institute, which will be held on April 4th to 7th, 1932, at centres arranged to suit candidates. Superintendent engineers of the leading shipping companies recognise that possession of this diploma is proof of all-round ability in the technical subjects specially required as the foundation of a successful career as a marine engineer. Of particular appeal to apprentices is the annual offer of the Lloyd's Register Scholarship, value £100 per annum and tenable for three years at an approved university. The next examination for the scholarship will be held on May 9th and 10th, 1932, at various centres. Full particulars may be obtained from the Secretary, Institute of Marine Engineers, 85, The Minories, London, E.C. 3.

FOLLOWING the recent exhibition of chemical apparatus in London on July 13th to 18th in connection with the jubilee celebrations of the Society of Chemical Industry and the Achema exhibitions organised by the Dechema, the German Society for Chemical Apparatus, a similar exhibition in Paris in 1932 is under consideration. According to *Nature*, the Achema has now received from France, from the Société de Chimie Industrielle, a proposal that these exhibitions should be held alternatively in each of the three countries concerned, an arrangement which would have the advantage not only of avoiding the simultaneous occurrence in different countries of such exhibitions, but also of affording opportunities for the mutual study and comparison of the methods of production in the different countries. It is expected that an international exhibition of chemical apparatus and plant will be held in Paris in 1932, followed by a German exhibition (Achema VII.) in Cologne in 1933, and a similar British exhibition in London in 1934.

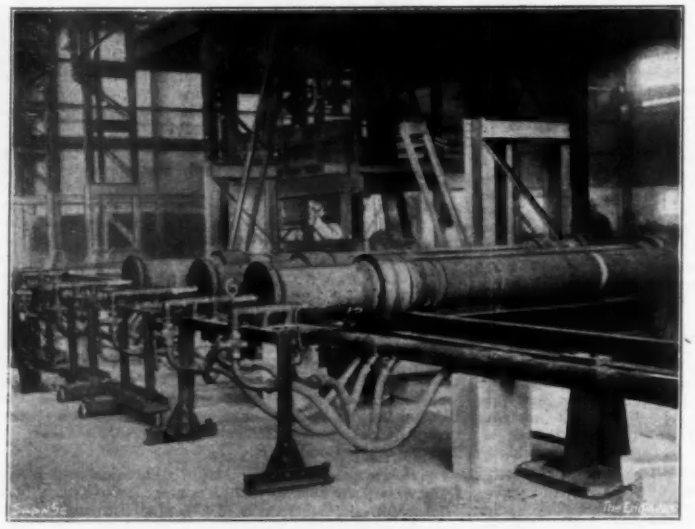
DURING the course of a recent luncheon arranged by the British Works Management Association, an address was delivered by Mr. G. Hurford, the chairman of the Association. Mr. Hurford said that confidence abroad was of little use unless it was supported by confidence at home. Unless the country generally had a reasoned faith in the future of our industries, and in the capacity of those engaged in managing and directing them, the prospects of an early revival of trade would be extremely remote. Most of the criticisms of our industrial ability were made by people who did not appreciate the enormous strides which had been made in recent years in raising the standard of productive efficiency. It should be remembered, however, that the British manufacturer was labouring under more handicaps than his foreign competitors in the way of taxes and other non-controllable costs. One of the most important figures in industry in the future would be the works manager, who, in a sense, would be primarily responsible for Britain's industrial future. His task, however, was full of difficulties, and the community would be well advised to give him every encouragement, and to refrain from making unwarrantable reflections on his ability and vision.

SAND SPUN PIPE PLANT AT STAVELEY

(*For description see page 322.*)



GENERAL VIEW OF THE PLANT



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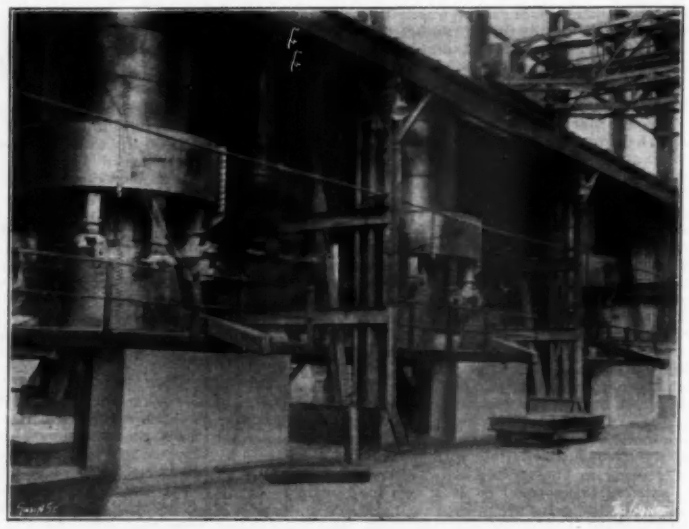

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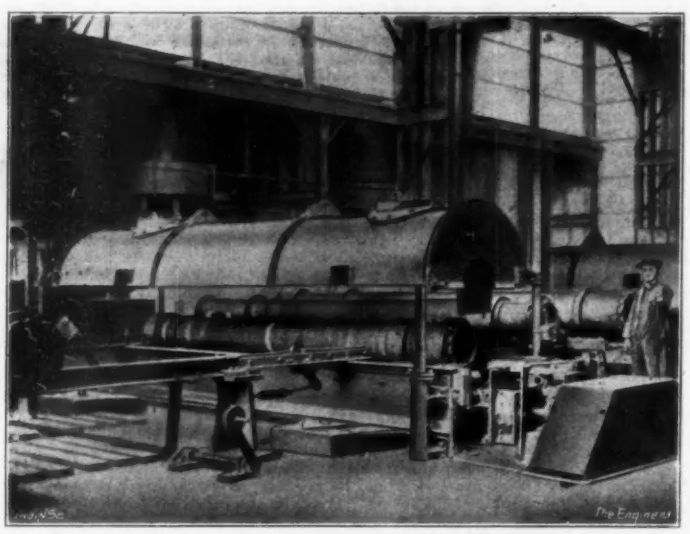

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THE ENGINEER.

VOL. CLII. No. 3950

SEPTEMBER 25, 1931.

The Balance of Trade.

RECENT events in Parliament, beginning with the formation of the National Government, and following with the Economy Budget and the departure from the gold standard, must have made even the most obstinately obtuse waver in their belief that the civilised world is moving towards the millenium through the supersession of principles and methods which resulted from years of experience and secular growth. They had been led to believe that the war had entirely changed the old established order, that a new kind of world in which everyone "would have a good time" had sprung from the ashes of battlefields, and that the discipline and restraint to which their fathers and grandfathers had subjected themselves in the period when Great Britain secured its pre-eminence in world trade were no longer necessary. Concessions made by Parliament and by industry to labour in all forms encouraged that view, and doctrines born in the New World, and apparently justified by events there, encouraged the dangerous faith that extravagant living was wise living. In America everyone mortgaged the future; they lived on their debts, and were taught that by so doing they encouraged trade, multiplied their earnings, and ensured for themselves an ever improved standard of life. In nearly every rank of society a revulsion from the restrictions and sacrifices of the war brought about an eagerness to enjoy life, and to throw to the winds the sober but wise teaching of the now contemned Victorians. Extravagance—State, municipal, and personal—ran rampant in the richer nations, our own amongst them. We refused to see whither our course was leading. The awakening came when foreign trade began to fall off and unemployment rose to alarming figures. But even then, when economy should have been immediately insisted upon, the Government increased its commitments, taxes which restricted commerce increased, wages in sheltered industries were allowed to remain at an excessively high level, and there was a persistent resistance to any attempt to lower the standard of living. The result was a disaster. The unemployment figures rose and millions of money had to be taken annually from productive industries to support nearly one-fifth of the industrial population in idleness. No country can do that for long. It implies expenditure of capital; for money is given away without any service or production to balance it. To Great Britain, depending as it does upon a favourable balance of trade, it is especially disastrous. The result which has now occurred could have been foreseen. The balance of trade has gone against us, and measures of the strictest economy have become essential to our very existence as a nation.

Our economic plight has led to the propounding of various remedies; they range from a complete reorganisation of a financial system which for years has been the admiration and envy of the world, to the imposition of such a tariff upon foreign goods as would prevent all competition in the home market. We do not propose to discuss any of the cures that have been advanced, but we would say this with regard to any and all of them that unless the recovery of the favourable balance of trade—that is to say, our overseas commerce—is their primary object, and unless we can be sure that they will effect that purpose, they must be rejected. Unless they can so do, not only the decline of this country from her great position, but her diminishment to an insignificant island, is certain. Foreign trade is absolutely essential to us, and no measure of whatever kind which does not restore it can avail us, whilst every measure which may directly or indirectly tend to increase the cost of manufactures in this country and so depreciate our power to compete with other countries in open markets, can only hasten an inevitable end. The object upon which we must concentrate our minds in this serious issue in our affairs is the sale of our products or our services to foreign nations. That is the one essential of the day. Let us not delude ourselves into the belief that a plentiful home trade would save us. It would do nothing of the kind, unless it were accompanied by an expanding foreign trade. Indeed, it is by reversing the order that salvation is to be sought; let us find the foreign trade and home trade will follow. How is that to be done? We do not share the pessimism of some sympathetic observers which leads them to the conclusion that the rise of manufacturing industries in the four corners of the globe has deprived Great Britain for ever of the possibility of retaining an important place in world markets. But we are compelled to admit that some of the once favourable conditions are gone, and that unless we have, on the one hand, something exceptional to offer, or, on the other, can outstrip competing nations in cheapness of production, the likelihood that our commercial position can be retained is indeed remote. It behoves industrialists, then, to consider two alternatives—one, the provision of something which no other nation can give, and the other, the reduction of manufacturing and other costs to a point which brings them at least to the level of those of competing countries. To the former we may look with hopefulness. In our reputation for high quality we have an asset of incalculable value which has stood us in good stead in the past as it will in the future. But limiting ourselves to engineering, we see little probability that we shall ever be able to compete in the matter of cost alone with those continental countries which are definitely satisfied with a lower standard of life. It may be taken for granted that the same kind of equipment is open to all nations, and that no secret process or invention will give one a preponderating advantage. In the end, the cost of labour per piece becomes the measure of the final cost. By reducing the amount of labour, the difference between low rates and high rates may be diminished, but it can never disappear. It spreads, not only through the actual product, but through all the buildings and plant that are necessary for the making of that product, and through the raw materials which have to be consumed. Hence, it may be said with certainty that as long as higher rates of wages are paid in this country than in other countries, equality of competition on price is almost an impossibility. It may be secured temporarily, owing to some localised improvement, but it cannot be retained. When to high rates of wages we add social services—which impose a tax upon earnings for the benefit of labour—the search for equality

becomes well-nigh hopeless. As there is little likelihood that the people of this country will ever countenance a reduction to the level of life of some competing nations, it seems that we must look in the other direction to which we have referred for the maintenance of our foreign trade. This country has always enjoyed a high reputation for the excellence of its engineering products. That reputation has been of the greatest value to it, and in numberless cases British goods have been accepted at an appreciable higher price than foreign goods, simply and solely because the purchaser was satisfied that the quality would be better. It is therefore of the first importance that we should retain our reputation for quality—in which we include many factors—even whilst every means of reducing the cost of manufacture is sought.

We have indicated, without any attempt at detail, one or two of the issues which the engineering industry must face if it is to play its just part in recovering the balance of trade. We have discussed the difficulties, but not in a despondent spirit. The traditions and genius of this nation of engineers will lift it out of the troubles by which it is now beset. In many respects it still enjoys exceptional advantages, amongst which the motherhood of a vast empire must be given the first place. The kinship of the Dominions overseas will, in time, assert itself to the mutual advantage of the Mother Country and her children. But apart from that, the revival of trade which must inevitably come about will bring orders to British engineers, and help towards the reduction of an incubus of taxes and rates which has weighed disastrously upon industries, and is, in a measure, responsible for the difficulties in which not only we, but all other nations, are now involved. The object upon which we must direct our energies, at whatever personal sacrifice, is the recovery of foreign sales in all kinds of commodities, for without them the re-establishment of the balance of trade can never be secure.

X-Ray Crystal Analysis.

WHEN the fundamental significance of X-ray crystal analysis was first enunciated by Sir William Bragg, following the epoch-making discovery of Professor von Laue, the whole scientific world was quick to perceive the comprehensive nature, and consequent potential value, of the new method of investigation. So enthusiastic was the reception of this new branch of science that immediate industrial applications and the solution of many perplexing problems were envisaged. Of late years engineers have taken considerable interest in the development of radiology, as applied to engineering processes. Articles on the subject have appeared in THE ENGINEER on February 21st, 1930, and July 4th, 1930; a descriptive paper was presented to the Institution of Mechanical Engineers towards the end of last session; and the appearance of a Report by a committee—under Sir William Bragg—of the Department of Scientific and Industrial Research was referred to in our "Journal" page on September 11th. The engineer's interest, however, is essentially concerned with the practical outcome of research. Does it contribute to the immediate solution of his difficulties? Fundamental research he is content to leave in its proper place—the research laboratory—until such time as it emerges as a factor in practical politics, and his interest in it is generally proportional to the probability of its developing into practical utility within a reasonable time. The busy engineer has but little leisure for the perusal of scientific papers, even if he possesses the necessary knowledge to apprehend their real significance. This fact is important when the question of collaboration is raised. Collaboration is only of value when both parties speak the same language. Therefore, as in this case it is the physicist who has the goods to sell, he must be prepared to define the probable value of his wares in terms of the engineer's requirements. In other words, he must say what he can do, and he must also define his limitations.

No doubt the X-ray Committee has this desideratum in mind when it so properly emphasises the need for close co-operation between the physicist and the various industrial specialists. Let us consider, then, to what extent X-ray spectrum analysis can provide a useful tool for the engineer. It is a process by which crystal structures may be investigated and measured, by which some of the properties of a metal may be explained, as, for example, the increased strength imparted to iron by the introduction of carbon atoms into the iron lattice. Crystal analysis may also be used to measure the distortion of a crystal lattice and to explain, to some extent, the probable cause of such distortion. It may also be used as a sensitive index of grain size, and consequently it has an important use in determining the extent of previous heat treatment which a metal has undergone, and it shows differences in structure consequent on recrystallisation. Further, as the D.S. and I.R. report illustrates, by means of some beautiful spectra, it may be used to show differences in fine structure which correspond to different types of scale at different places on a specimen of high-pressure boiler steel. Furthermore, it is the only method by which the orientation of metallic crystallites may be studied and its modification by heat treatment observed. These examples indicate the sort of information which may be obtained by X-ray crystal analysis of metals, and it must be understood that the subject is capable of further progress along all these lines. At the present stage in its development, the crystal analyst uses the knowledge concerning metals already possessed by the metallurgist to explain his X-ray spectra. Can the engineer recognise that development along the lines roughly indicated is going to be of practical importance to him? As Dr. Lister very truly says in the May number of the *Journal of the Franklin Institute*, "X-ray diffraction methods for the study of metals comes within the category of fundamental rather than applied research. . . . They do not give specific information about the hardening of copper, but they do give very definite information as to the nature of hardness." The valuable work of Dr. Arne Westgrin and others on the constitution of steel and other metals falls within Dr. Lister's category, but this does not mean that it is not of the highest importance. There is no doubt whatever that in time this work will result in a clear understanding of the fundamental nature and properties of complex steels which at present are so perplexing; but it is not easy to say at the present time how the research will develop, or in what direction it is most likely to result in success. The problem itself is by no means defined, and X-ray investigations are necessarily exploratory in character. It remains, then, to estimate the probability of this important fundamental research developing into a practical engineering tool. It should be remembered that X-ray spectrum analysis, as a very highly specialised branch of physics, will always demand the services of a highly trained physicist, both in actual experimental work and also in interpretation of results. In this it differs from microscopy, which has become of such vital significance in metallurgy, very largely because of the possibility of its universal employment. There are, however, certain engineering problems of the highest importance, such, for example, as welding, which may very well benefit almost immediately by the employment of X-ray crystal analysis, because it can be used to give valuable information concerning the condition of the metal adjacent to a weld. This technique, which has been extensively developed and used in the Research Department at Woolwich, has the advantage that it may be employed by comparatively unskilled workers, not as a method of inspection of welds *in situ*, but as a method of investigation in the ordinary works laboratory. Moreover, the interpretation and significance of the spectra may be easily understood by the practical engineer after very little experience. Consequently, this is a line of investigation which, from the engineer's point of view, is of the greatest importance. The same technique may be used to investigate grain size, orientation, and recrystallisation, and may prove of great value as a consultative method in casting research. The D.S. and I.R. report refers to some valuable work that has been done on the investigation of electro-deposited metals. Here, again, there seems to be immediate promise of useful results. Electro-deposition has achieved very great importance of late. The subject has been intensively developed in many centres, particularly in the Research Department at Woolwich, where X-ray analysis has been found to yield information of very great value concerning the various types of orientation of the deposits, and consequent differences in their physical properties. The Report unfortunately makes no mention of the application which may be sought in chemical analysis in cases where conventional methods are inadequate.

If, from the engineering point of view, the report just issued by the D.S. and I.R. on "The Applicability of X-ray Crystal Analysis to Industrial Problems," is somewhat disappointing in that it does not deal with any of the really important problems which confront the engineer at the present time, tribute must be paid to the valuable pioneer work that has been done on the subject of X-ray crystal analysis, both at the N.P.L. and other centres in England. The Report contains results, the excellence of which can only be properly appreciated by the expert. They are frankly of a pioneer character, but, even so, they are of definite interest and importance to many different industries. The full value of the method will be more appreciable in engineering when it becomes more nearly related to practical problems, and when it affords primary data upon which constructive improvements may be based. We observe with satisfaction that "arrangements are being made for detailing suitable officers from the N.P.L. for temporary work in selected industrial centres," as that activity must, surely, increase the contact between the scientist and the industrialist, and hasten the arrival of the moment when this remarkable method for the examination of materials takes its proper place, whatever it may be, in the works laboratory.

Faraday Centenary Celebrations.

As part of the Faraday Centenary Celebrations, a Conference organised by the Institution of Electrical Engineers was held at Kingsway Hall, London, on Tuesday morning, September 22nd, when Mr. C. C. Paterson, President of the Institution of Electrical Engineers, presided over a large attendance, including many foreign guests. The Conference took the form of a number of addresses on "The Place of Electricity in the Terms of Utilisation of Power and Transport, Communications, and in the Household."

The first speaker was Mr. J. S. Highfield, who spoke on the subject of "Power." It was wonderful, he said, to realise that only in the last hundred years had man enjoyed the use of easily available power, and only in the last fifty years had he enjoyed power in quantity at any place where he desired it. After a brief reference to the mechanical engineering developments during the hundred years from 1770 to 1870, including Arkwright's patent for a complete cotton mill and the extension of Watt's patent, Mr. Highfield said that without Faraday—without electricity—Parsons great invention of the steam turbine would in all probability never have been developed for use on land, certainly not in large sizes, and the evolution of steam and internal combustion engines would have been on different lines from those we know. The time interval between Faraday's discovery and the common use thereof was considerable, measured by the span of one man's life. Fifty years elapsed before the first Act of Parliament was passed controlling the supply of electricity to the public, and twenty years more before the Acts enabling companies to supply electricity over spaces measured by counties. Another generation went by before the Act which made the United Kingdom the area of supply was passed. Thus, nearly 100 years were required before Faraday's electrical discoveries were made of common use to mankind. In this country alone the capital employed in public electricity supply amounted to some £350,000,000, and, depending thereon, were the great manufacturers of plant, both large and small. Even so, we were but at the beginning of the uses of electricity. Our methods were still elaborate and costly, and they called for great simplification. Already, however, work done in other directions—wireless transmission, for instance—began to point the way to new methods. By further discoveries, and not far distant ones, we soon might be considering the distribution of power derived from water and fuel over continents; we might see the way to use fuel more efficiently, and find a means of transmitting electricity at less cost. That these and other improvements would be effected, the present rate of progress in all sciences relating to electricity made a fairly certain assumption.

Sir Josiah Stamp, who spoke on "The Place of Electricity in Transport," said the discoveries of Michael Faraday 100 years ago had had an influence in the field of transport which was profound, but was certainly not immediate, nor could we say that it was yet final. Indeed, we stood at the parting of the ways, when it was impossible to say whether transport was to be continuously modified by developments in the future, or completely revolutionised; whether electricity would be an auxiliary to the other main forms of power, or whether it would supersede them. On the rail itself, until recently, it would have appeared that the advance of universal electric traction was only a matter of time and capital, but in two directions there was now to be seen some check. In the first place, with all kinds of electrical devices for signalling, track circuiting, &c., and the further development of the steam locomotive, intensity of track capacity, economy and speed might still find great possibilities of advance. Secondly, Diesel and other self-contained units were holding out new promise which could not be brushed aside as unimportant. It was, however, in the application of electricity to suburban line working that its indispensability was most apparent, and our indebtedness became more

pronounced as time went on. There were also other cases in which steam locomotion, owing to its limitations, was unable to meet the requirements of the traffic, such as services with frequent stops, necessitating rapid acceleration and deceleration, and lines with heavy gradients. Regenerative braking was an important advantage of electric operation. The future of electric traction in this country, however, was a very contentious subject at the present time, and one demanding very careful and complete investigation in a country whose greatest source of natural wealth was coal. If there were a market for our better grades of coal, so that the inferior grades were more or less automatically produced in large quantities, the problem would be greatly simplified from a national point of view, as the inferior coal, being practically a by-product of the more expensive coal, could be consumed in super-power stations and converted into electrical energy at a very low cost. The fact was, unfortunately, that the market for the more expensive coal was diminishing every year, largely owing to the fact that our customers without coal of their own were now using electricity generated from water power, and also owing to the conversion of ships to oil burning. Progress would undoubtedly be made with the more efficient extraction of energy from coal, and developments on those lines would have a very important bearing on the question of electric traction.

Miss C. Haslett, director, Electrical Association for Women, said that no better tribute could be paid to the work of Faraday than to call attention to the manner in which electricity was now being used in the household. At the same time, whilst electricity in its applications to the household had made enormous strides during the past twenty years, it was amazing that only 32 per cent. of the houses in this country were wired for electricity. One cause was that electricity was still erroneously regarded as very costly when used for power and heating purposes in the home, and that pointed to the need for more educational and propaganda work on the running costs of electrical appliances. Another reason for the backward state of affairs referred to was the lack of wiring points for the use of appliances in homes and the need for electrical appliances to be made available to the public on easy terms. Yet another reason was the curious fear of electricity and lack of knowledge of electrical appliances on the part of many women in the country. That could be overcome by teaching school girls simple electrical knowledge and the application of that knowledge to home life. Another factor in the situation was the technical language used, which mystified the housewife. A simplification of electrical terms was necessary, and also greater standardisation of apparatus. With a suitable tariff, facilities for assisted wiring and for the obtaining of electrical apparatus on easy terms, the further need would be for that of education, and she suggested that the electrical industry should consider the advisability of employing a larger number of well-trained women in electrical housecraft for lecturing and demonstrating to the homemaker the many uses of electricity. The maid of the future should be able not only to use electrical appliances efficiently, but should be capable of doing minor repairs and keeping the apparatus in good working order.

Mr. Ll. B. Atkinson, who also spoke on the domestic applications of electricity, said Faraday was once asked in connection with what he had discovered, "Is it of any use?" The answer was that Faraday's discoveries had led to the solution of the domestic problem. In England to-day the better-class people complained that they could no longer get servants, and many of them seemed almost in despair. They gave up the attempt to have a home, and lived in hotels, boarding-houses, service flats, and other ways of escape from the difficulty; but they lived expensively, because they paid for all their service instead of performing it themselves. What was the alternative? Was it possible to live a life with leisure and opportunity for culture without servants? There was no need to ask that question and leave it unanswered. The answer was that it could be done, and was being done. It was all a matter of planning, of proper design of the house, and being trained to use what science had to offer. Whilst in the manufacture of goods enormous progress had been made to make lighter the work of the human individual, in the house we had advanced very little from the organisation which had existed for hundreds of years. The middle and operative classes could not afford to live in hotels and service flats, and therefore he envisaged blocks of flats where every task that could be done electrically would be so done in spacious and convenient kitchens, laundries, sculleries, &c., for the residents in those flats, and that only a minimum of family work need be done. What a gain in health and comfort! He had estimated that a woman who now worked continuously all day and every day would only need to put in the equivalent of two days' housework each week in such an organised home. He earnestly suggested that some of those who were thinking and working to face modern domestic problems should give such a plan their serious consideration.

Sir Oliver Lodge, F.R.S., spoke on "Communications," and said that what Faraday really discovered was the properties of space near and surrounding electrified and magnetised bodies. The whole tendency of physics was to look more and more at what was called vacuo or ether which was the place where the energy existed. All the energy was in the ether; matter was only our means of exploring the ether and seeing what the forces were. Faraday's part in electrical engineering had been but a small laboratory achievement, but it had produced enormous consequences. He concluded with an expression of the hope that world communication introduced and developed by engineers based on Faraday's work, would have the effect of bringing the nations of the world together and put an end to the application of science to the provision of means for conflict and mutual destruction.

The President, in bringing the meeting to a close, said that the discoveries of Michael Faraday were not the greatest things connected with him, because every student who had come to Faraday to learn of his work stayed to do homage to the spirit which inspired him. The discoveries made took on a new set of values when contrasted with the simple and modest honesty of his character, and the indomitable courage and pertinacity by which his genius for experimental investigation was made fruitful. If Faraday had not found out the secrets of electric induction and established the broad theory which explained the phenomenon of the electric current, others coming after him would certainly have done so, although, in that event, the theory might have been evolved more slowly and without that unerring directness which had made Faraday's electrical investigations a masterpiece in the art of experimental research. Why, then, did his contemporaries, and why had succeeding generations held him and his work in such especial esteem? The answer to that question revealed the secret of Faraday's genius. Faraday had a supreme reverence for truth and a great love of science. His work was inspired by an unshakeable faith in the essential unity of all physical phenomena, and the determination to discover the nature of that unity dominated all his thoughts and governed his experimental projects. The discoveries which had meant so much to humanity were the mere by-products of that search to establish the fundamental plan of things. The influence of Faraday upon scientific research in Great Britain had been profound, because he made ordinary people understand science and its objects. He made science appeal to the popular imagination and science became a career—a respected occupation to which young men of brains and ability were drawn. Truly, the harvest had been great. And what of the future? If our visions for the future of electricity were to be realised, it would be in the measure in which we produced men and women of the same sterling characteristics as Faraday and with the same ideals of self-effacing service. It would also depend on the extent to which we are able to carry practical research into every phase, new and old, of applied electricity. The progress of that movement in Great Britain during the past ten years had been phenomenal, and it gave ground for the assurance that electrical engineers had accepted the research man into true partnership in the heavy responsibilities they carried.

In concluding the proceedings, said the President, and in reviewing the successive pictures which the various speakers had painted, he wished to focus attention on the one thought which stood at the centre of all that had inspired them—the man Michael Faraday, his character and his influence—for, in the ultimate issue, it was through men and not through science that the world achieved its truest progress.

The conversazione of the Institution of Electrical Engineers was held on Wednesday evening in the Albert Hall, to which the Faraday Exhibition—dealt with elsewhere in this issue—attracted a very large attendance.

The Wireless Exhibition.

THE Radio Exhibition, which was opened at Olympia on Friday, September 18th, and which closes on the 26th, is the largest that has been held in this country. Organised by the Radio Manufacturers' Association, it is devoted entirely to British products made almost entirely by members of the Association. Every desire of the listener has been anticipated and met, and innumerable receiving sets are on view. Compared with earlier exhibitions, the show is gigantic, and judging by the attendance, it is a thoroughly popular show. Whilst in the past the exhibitors seemed to be inclined to cater more particularly for the amateur constructor, the present desire is undoubtedly to sell complete sets, or "kits" which can be put together without any technical knowledge or skill.

The reduction in the prices of complete wireless receivers has done much to discourage the purchase of component parts and the manufacture of sets at home. Although the Exhibition caters for the home constructor, the majority of the exhibitors are showing complete receivers, many of which are offered at low prices. Crystal sets and headphones are conspicuous by their absence. "All mains" valve sets, and gramophone radio sets, on the other hand, are more numerous than ever. But although the "all mains" receiver is making rapid headway, the leading battery manufacturers are in evidence, as well as makers of battery charging equipments. There are, of course, still many listeners who have no electricity supply, whilst others are disinclined or unable in these hard times to go to the expense—small though it is—of providing the necessary apparatus for taking their supplies from the mains; but as electricity supplies penetrate into parts at present without electricity, and as more houses are wired for electric light, the demand for batteries is pretty certain to show a marked decrease. Meantime one well-known wireless firm has introduced a device which enables a receiving set to be worked entirely from the L.T. accumulator, which, in addition to supplying the valve filaments, provides the H.T. supply. For the latter the low-tension current is supplied to a make-and-break coil, which raises the pressure. The H.T. supply thus produced is then rectified and smoothed and supplied to the plate circuit.

There are many examples of two and three-valve receivers with and without loud speakers, and some are in the form of radio gramophone sets; others have terminals to which a pick-up may be connected. Mains sets are shown with illuminated timing dials. One of the most interesting sets which came to our notice was the "Stenode Radiostat" receiver, invented by Dr. James Robinson, and claimed to be many more times selective than sets constructed in accordance with recognised principles and far less liable to interference. In order to demonstrate the high selectivity which may be obtained with this receiver two modulated oscillators have been arranged so that they are operating as miniature transmitters with carrier frequencies 5 kc. above and 5 kc. below the London Regional Station, each being modulated by gramophone records. There are therefore three transmissions with frequencies of 837, 842 and 847 kc. respectively. With the Stenode receiver any one of these three transmissions is readily picked out from the other two and reproduced with excellent quality and without interference.

Of the many loud speakers exhibited and demonstrated the most novel is probably the "primustatic" speaker, which is an electrostatic instrument without coils or magnets, but as the instrument was not in operation we are unable to say anything about its performance. Many other loud speakers are, however, working in the demonstration rooms, and the reproduction in some cases is exceptionally good. There are no fewer than twenty-five demonstration rooms on the first floor of the building, most of which are well attended.

Although the Exhibition is, of course, mainly devoted to wireless apparatus for the reception of broadcast programmes, there are exhibits of a different character. On one stand, for example, recording instruments are shown for making gramophone records at home, whilst on another stand there are condensers suitable for power correction as well as for wireless purposes. The Baird Televisor is also in evidence, but on this occasion it is not being demonstrated. As a popular show the Exhibition is to be regarded as instructive, and if people find that they still have enough money to pay taxes and purchase wireless goods, it should serve to stimulate business.

BOOKS RECEIVED.

Advancing Science. By Sir Oliver Lodge. London: Ernest Benn, Ltd., 154, Fleet-street, E.C. 4. Price 6s. net.

Journal of Research of the Bradford Technical College. Volume I., 1930. Bradford: Bradford Education Committee.

Mathematics. By B. B. Low. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 12s. 6d. net.

Electricity and Magnetism. By S. G. Starling. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 6s. net.

Wirtschaftliche-Stutzung von Traggebilden. By M. Ing. R. Schönhöfer. Leipzig: R. Noske, Universitätsstrasse 8, Germany. Price 15 marks net.

Through Tariffs to Prosperity. By H. G. Williams. London: Philip Allan and Co., Ltd., 69, Great Russell-street, W.C. 1. Price 7s. 6d. net.

Linoleum Handbuch. By M. H. G. Bodenbender. Berlin: Chemisch-technischer Verlag Dr. Bodenbender, Feuerbachstrasse 6. Price 13s. 6d. net.

Chemistry in the Service of Man. Fourth edition. By A. Findlay. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 6s. net.

Kingston's Continental Price Conversion Tables. By A. G. Kingston. London: Kingston's Translations Institute, 96, Leadenhall-street, E.C. 3. Price 4s. net.

The Weekly Weather Report. March 2nd, 1930–February 28th, 1931. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 15s. net.

Staubausscheidung an einfachen Körpern und in Luftfiltern. By Dr.-Ing. W. Sell. Berlin: V.D.I. Verlag G.m.b.H., Dorotheenstrasse 40, N.W. 7. Price 4·5 marks.

British Engineers' Association Classified Handbook of Members and their Manufactures, 1931. London: The British Engineers' Association, 32, Victoria-street, S.W. 1.

A Short History of Imperial Preference. By Major the Rt. Hon. G. C. Tryon. London: Philip Allan and Co., Ltd., 69, Great Russell-street, W.C. 1. Price 2s. 6d. net.

A Register of Civilian Aircraft. Compiled by W. D. Manning and R. L. Preston. London: Sir Isaac Pitman and Sons, Ltd., 14, Parker-street, Kingsway, W.C. 2. Price 2s. 6d. net.

The Faraday Exhibition.

No. I.

IF the Faraday Exhibition now being held at the Royal Albert Hall had been organised solely with a view to showing Faraday's experimental apparatus and with the object of demonstrating exactly what he did, it would have been a fairly simple affair, but as it is also intended to show the results of his discoveries, it naturally assumes a totally different form. Together with coils, magnets, &c., which were used by Faraday at the Royal Institution, and apparatus employed by other early electrical workers, there are many things that are associated with modern electrical engineering, such as electric lamps and machines for making them, cables, automatic telephone equipments, broadcast transmitters, and the B.E.A.M.A. working model of a large power station—see Fig. 1—described in our last issue. Apart from the interest which he took in electrical science, Faraday paid much attention to chemistry, a fact which has not been overlooked by those who have organised this instructive show. While still a young assistant to Humphrey Davy, and before he became famous as an electrical investigator, he did important work on the condensation of gases, and the refrigeration plants of to-day are a consequence of the growth of scientific knowledge of this subject. When he was thirty-four years of age, he isolated benzene, finding it in the residues left in the cylinders in which illuminating gas was at that time stored for distribution. Largely upon the chemistry of benzene and its associated substances organic chemists have built their science, and although Faraday knew nothing of the dye industry or of the many other industrial developments, he is looked upon by the chemists as a pioneer.

It was in 1831, however, that he made his most startling and important discovery by showing that it was possible to generate electric current by the relative motion of conductors and magnets. Briefly, the fundamental experiment on which the operation of all electric generating machines is based is that of plunging a magnet into a coil of wire. Faraday found that on inserting the magnet a galvanometer connected to the coil gave a deflection, and that on withdrawing it the needle was deflected in the opposite direction. As we said in our last issue, the apparatus appertaining to Faraday's 1831 work has been arranged by the Royal Institution. Among these exhibits is a large model of the well-known ring he used on August 29th, 1831, a modern form of equipment for showing the effect more strongly, a replica of Faraday's coil and bar magnet used for the experiment to which we have alluded, and other apparatus with which most electrical people are familiar. It would take far too much space, and it would scarcely be fitting in an article of this nature, to describe all the electrical experiments Faraday made and to deal with the conclusions he arrived at. Let it be remembered, however, that his activities were far-reaching. His discoveries in electro-chemistry, for instance, published between 1832 and 1839, placed the whole subject on a far sounder basis, and cleared away much of the cloudiness which at that time enshrouded the ideas of philosophers. He investigated many aspects of the subject, but there may be said to have been three main lines of research. First, he showed the identical nature of electricity, from whatever source it is derived; secondly, he demonstrated the strict equivalence of electricity and chemical action; and, thirdly, he proved that the current from the voltaic pile or cell is due to chemical action and not to the contact of different metals.

Faraday was not, of course, an inventor or an engineer, and having made his discoveries, it was left to others to develop them and put them to practical use. Modern electrical engineering is the outcome of the efforts of innumerable workers in the electrical field, and an interesting feature of the Exhibition is that in some measure it reveals the links between the work of Faraday and the modern generating station, exemplified by the model shown in Fig. 1. Although Faraday made his electro-magnetic induction experiments in 1831, the first industrial dynamo was not built until several years after. What appears to be the first industrial machine was a generator invented by Wooldrich, of Birmingham, in 1844, which was used for electro-plating. Together with other early machines which have been removed from the Science Museum, this generator is exhibited. At the end of 1831 Pixii built a generator, and a year later added a simple commutator, but, like other early machines, this was quite small and of no industrial value.

Some of the early dynamos exhibited by the B.E.A.M.A. are illustrated in Figs. 2 to 5. The machine shown in Fig. 2 is a copy of the important generator made by Saxton and exhibited by him before the third meeting of the British Association in 1833. In principle it is similar to Pixii's dynamo of 1831,

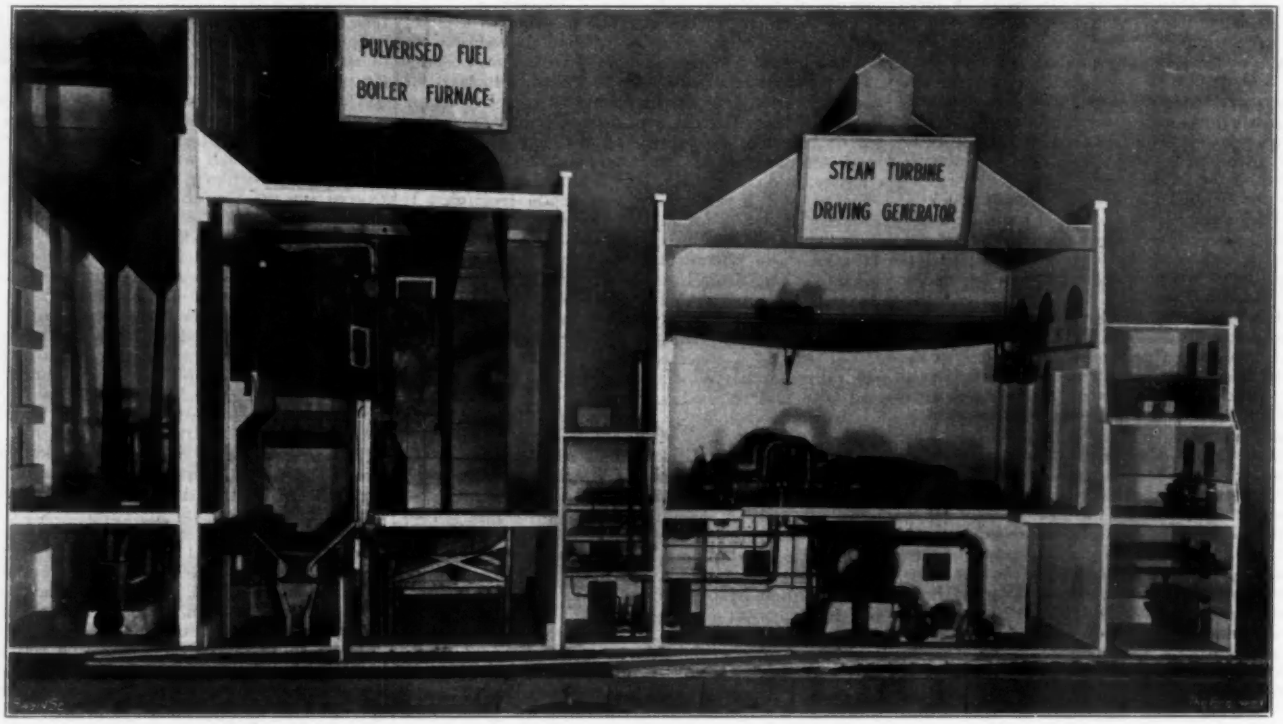


FIG. 1—POWER STATION MODEL

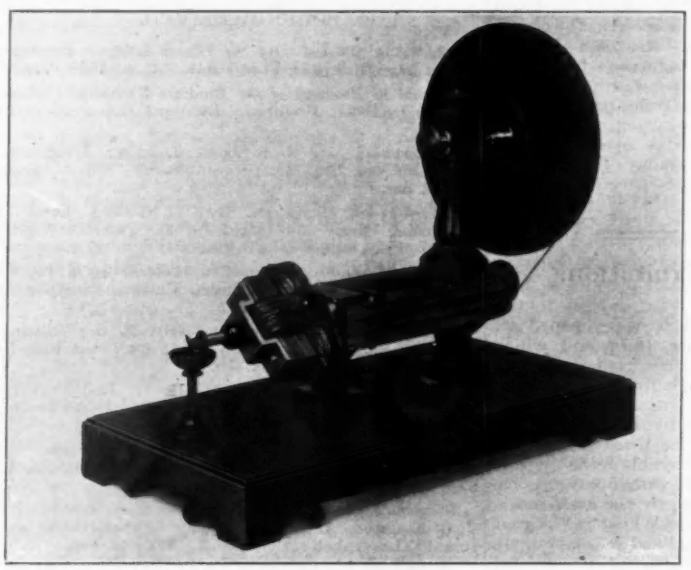


FIG. 2—SAXTON'S MAGNETO-ELECTRIC MACHINE, 1833

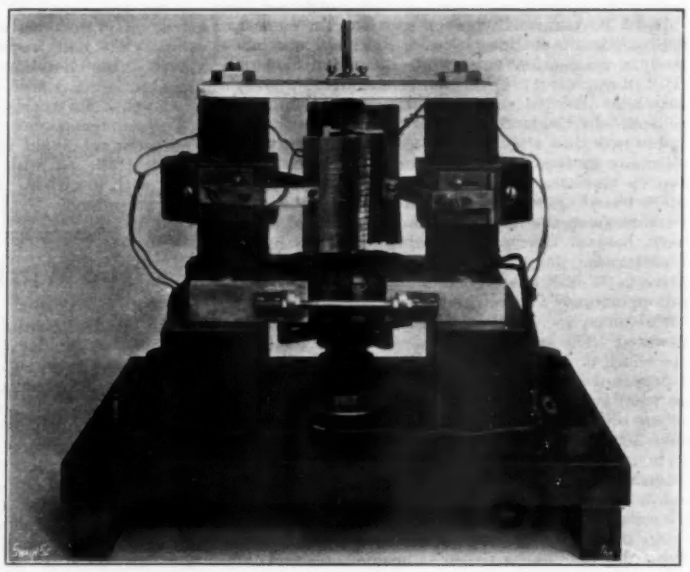


FIG. 3—PACINOTTI'S DYNAMO, 1860

but it differs in construction and arrangement. The permanent magnet has three laminations, and is mounted horizontally. A soft iron core wound with bobbins of insulated copper wire rotates before the end faces of the poles, and the current generated is collected from discs, which dip into mercury cups. The drive is by hand from a large pulley to a small pulley on the armature shaft.

The dynamo shown in Fig. 3 was made by Dr. Antonio Pacinotti about the year 1860. It was of outstanding merit at the time, and has the ring armature invented by Pacinotti and at a later date incorporated in the machines designed by Gramme. The armature core consists of a toothed wheel of iron between the teeth of which the coils are wound in sixteen separate sections. The coils are joined up in a closed circuit and connections are brought from sixteen points to the commutator, which is mounted on the vertical spindle above the armature. The field magnets are shunt wound and in the field circuit there is an automatic break in the form of a ring mounted on the shaft above the commutator. By means of this ring the current through the magnet coils is interrupted during a quarter of each revolution. It seems probable that this break was added for some experimental purpose, since no mention is made by Pacinotti in any of his writings of a similar device, nor is its purpose clear. The field magnets were either supplied with current from a voltaic battery or they were allowed to act as permanent magnets.

The separately excited dynamo shown in Fig. 4 was invented by Wilde in the years 1863–65, and described by him before the Royal Society in March, 1866. The machine exhibited closely accords with the

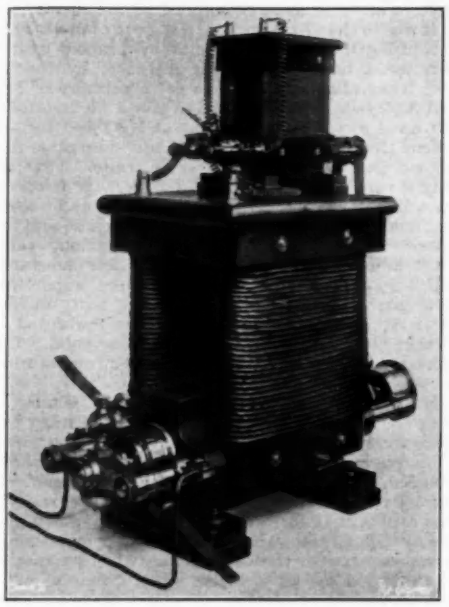


FIG. 4—WILDE'S DYNAMO, 1863

original description, except that the field magnets are wound instead of being permanent magnets. It has an electro-magnet formed of two plates of iron bolted together at the top through a wrought iron bridge. On this bridge a smaller dynamo which provides the current to excite the field windings of the larger machine is mounted, and a Siemens shuttle type armature is employed in each case.

Another interesting machine which is exhibited in the main entrance to the hall is the A.C. generator shown in Fig. 5, which was patented by Messrs. S. Z. de Ferranti and A. Thompson in 1882–83. The field magnets are stationary and consist of two sets of electro-magnets, each with sixteen projecting pole-pieces, between which the armature revolves. The pole-pieces in each set are arranged alternately north and south, while poles of the two sets facing each other are of opposite polarity. The armature consists of a continuous ribbon of insulated copper running to and fro radially in a number of layers forming eight open loops. There are two terminals connected with simple contact rings from which the A.C. is collected, while the magnet coils are excited by means of a separate continuous-current machine. In later forms of Ferranti alternators a different armature winding was adopted, a number of coils being wound separately and then combined into a disc. As time passed D.C. and A.C. generators naturally increased in size, and were improved, but, needless to say, no attempt has been made at the Exhibition to bridge all the gaps between these early generators and the large turbo-driven machines, as represented by the power station model, although Sir Charles Parsons' first turbo-alternator introduced in 1884 is on view.

Present-day practice in practically every branch of the industry is well represented and no small amount of attention has been paid to the British "grid." A large coloured map on the stand of the Central Electricity Board shows the complete scheme of the main "grid" transmission system, which, as everyone knows, has developed from the recommendations of the Weir Committee set up in 1925. Coloured lines indicate diagrammatically the routes of the transmission lines and the appropriate voltage at which they will be operated. Push-button switches are provided for illuminating the complete map or individual schemes, as required, and the public is invited to operate these switches if a detailed exhibition of any particular area is desired. The illuminated transparencies are made from photographic negatives which give a clear impression of the construction work which has actually been carried out on the various schemes. Faraday's original transformer weighed about 4 lb. The total weight of transformers, excluding tanks and oil, for the British "grid," will be about 10,000 to 15,000 tons, and transformers

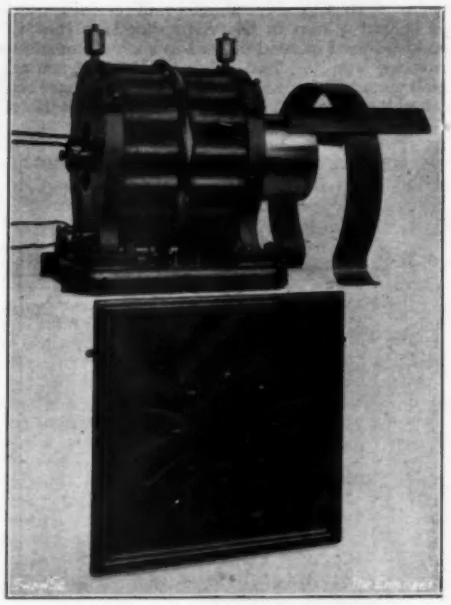


FIG. 5—FERRANTI'S ALTERNATOR, 1882

on distribution systems and consumers' premises amount to many times that figure.

Turning, for the time being, to the wireless side of the Show, the far-reaching effect of Faraday's discoveries are nowhere more strikingly shown than in the exhibits of the Marconi Company. Though limited in number, owing to the available space, they form one of the most interesting collections of historical wireless apparatus ever brought to the notice of the British public. Among exhibits withdrawn from the Science Museum for the purpose of the Exhibition, are replicas of apparatus used by Marchese Marconi in his earliest experiments at Bologna, in Italy, in 1895, and original apparatus used when he first came to England and gave demonstrations to the General Post Office and the Admiralty

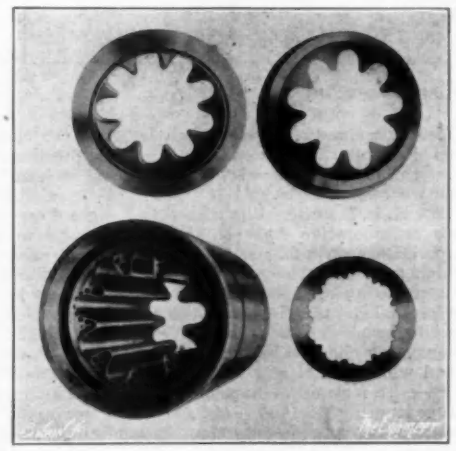


FIG. 6—ANODE PARTS

in London and on Salisbury Plain. There is a coherer receiver, an early Bellini-Tosi direction finder, and a directional transmitter introduced in 1907. The arc wireless telephone of 1910, and a series of microphones for wireless telephony are also on view, together with a historical collection of valves, including the experimental two-electrode valves made by Sir Ambrose Fleming between the years 1904 and 1908, and a 100-kilowatt valve as used in the largest broadcasting stations.

The kites employed by Marchese Marconi in the first Transatlantic experiments between Poldhu and Signal Hill, in Newfoundland, which demonstrated the possibility of world-wide wireless telegraph communication, are also to be seen. Whilst, owing to the limitations of space, it has not been possible to include any modern commercial apparatus on the Marconi stand, one or two pieces of apparatus of this nature are shown in other sections of the Exhibition. These consist of a Marconi B.B.C. regional transmitter and the latest type of aircraft transmitter, designed for fitting in large aeroplanes and airships, one of the most important features of which is the inclusion of an independent drive circuit which ensures constant frequency of the radiated wave.

Perhaps the most remarkable modern wireless exhibit is a 500 kW thermionic valve, which was made by the Metropolitan-Vickers Electric Company for the Rugby wireless station, and which is being shown by the G.P.O. Apart from its large input, the valve is noteworthy because no glass is used in its construction, and because it can be taken to pieces and reassembled in a few hours. For many years wireless engineers have realised that the orthodox type of valve, which deteriorates with age and which presents difficulties in the direction of sealing off the electrodes in the process of manufacture, is far from an ideal piece of apparatus, and that a different form of construction which would enable the vacuum to be maintained, facilitate repairs and permit of higher output, would be a decided advantage. Whilst valves that are continuously evacuated by means of the mercury vapour pump have been operated satisfactorily under laboratory conditions, owing to the high vapour pressure of the mercury vapour and the need for the expensive process of liquid air-cooling, in order to maintain the vacuum, valves operated in this way have proved commercially impracticable.

Some years ago, however, experiments in no way

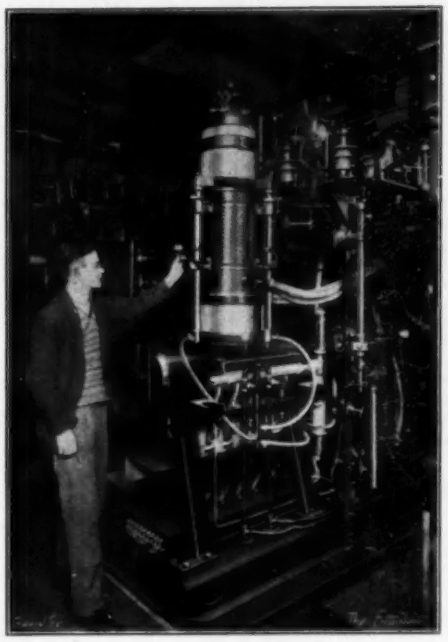


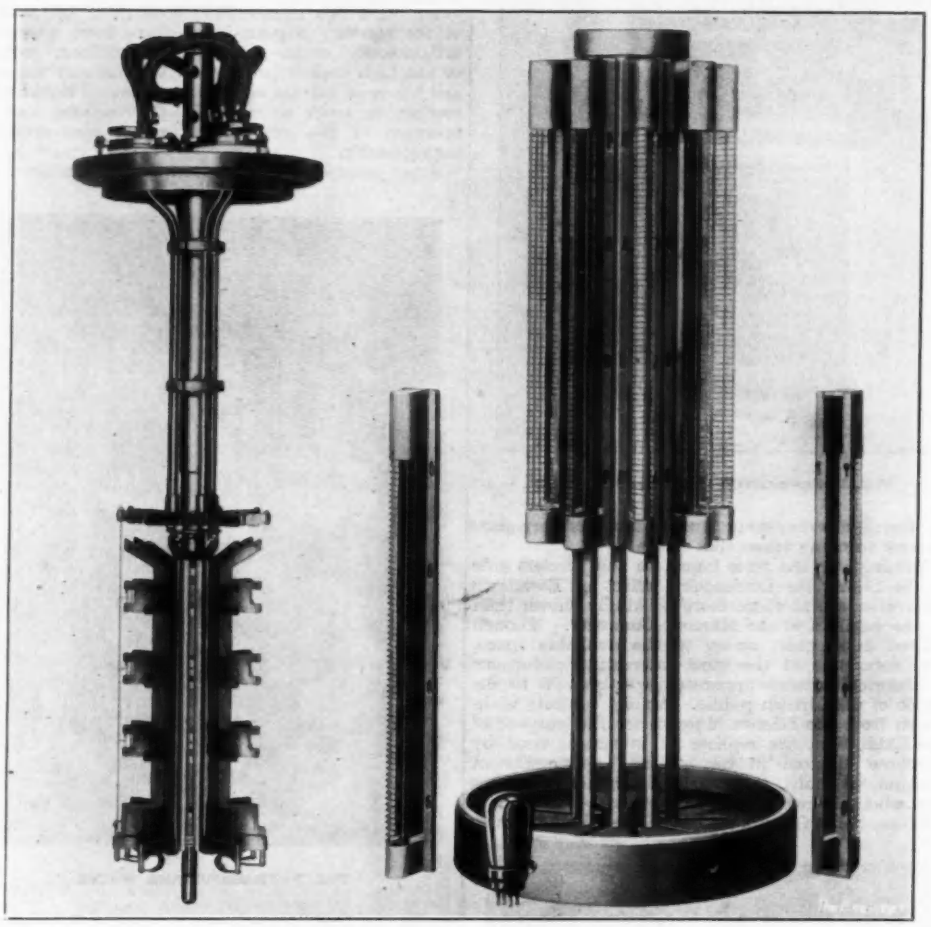
FIG. 7—TRANSMITTING VALVE

connected with wireless work, carried out in the Metropolitan-Vickers Electrical Company's laboratories, led to the production of oil distillates having remarkable properties. It was found that they could be boiled at a fairly low pressure without decomposition, whilst, at room temperature, their rate of evaporation was so small that they could be placed inside a wireless valve without impairing the vacuum. It was soon recognised that a liquid had been found that could replace the mercury of the vapour pump with great advantage, and, owing to its low volatility, cooling could be done with water, and the cumbersome and expensive liquid air process could be eliminated. As a result, the continuously evacuated valve became a commercial piece of apparatus, and in 1930 a valve designed for an input of approximately 25 kilowatts and incorporating this new principle was put into operation at the Rugby wireless station. As a result of its satisfactory operation, the G.P.O. entrusted the Metropolitan-Vickers Electrical Company with the manufacture of the 500-kilowatt valve under consideration. The valve shown in Fig. 7 is 10ft. long and 14in. in diameter; its weight complete is over 1 ton; the weight of the water-cooled steel anode, the parts of which are shown in Fig. 6, being 3 cwt. It is 14in. in diameter and appoximately 26in. long. The tubular arrangements to be seen around the valve in Fig. 7 are hydraulic rams, which facilitate dismantling and reassembly. The valve is built on a welded steel bed-plate, 8ft. long by 3ft. wide. The cooling water, which circulates in the passages to be seen in Fig. 6 and elsewhere, is supplied at the rate of 40 gallons per minute.

The filament assembly—see Fig. 8—consists of nine sections, and the connecting leads are water-cooled. For filament heating, a current of no less than 500 ampères is required, the filament emission being 160 ampères. The grid assembly, which is shown in

Fig. 9, also consists of nine sections, each controlling the emission from the corresponding filament section, and, as shown in Fig. 9, each section of the grid assembly, which is also water-cooled, can easily be removed. As we have said in the construction of the complete valve, no glass is used. The parts are composed of steel, porcelain and copper, which are the materials most commonly used in the manufacture of other classes of electrical equipment. As a result of the continuous evacuation the valve improves with age, any gas evolved during its operation being rapidly removed by the pumps, which, with the exception of the simple primary extractor, have no moving parts.

Even at the highest power inputs, an exceedingly high vacuum is said to be maintained. Compared with the ordinary type of valve, which deteriorates with age and which can only be made for relatively small inputs, and which does not readily lend itself to repairs, the new type of valve offers marked advantages. By the adoption of the principles embodied in the design of this new apparatus, it will be possible to construct valves with inputs considerably greater



FIGS. 8 AND 9—FILAMENT AND GRID UNITS

than 500 kilowatts, and applications in the field of power engineering are considered to be well within the range of possibility. At the Rugby wireless station, the new valve is capable of operating the main transmitter and of replacing a bank of fifty valves of the ordinary type.

For permission to reproduce the illustrations, Figs. 2—5, we are indebted to the Director and Secretary of the Science Museum.

(To be continued.)

The Institute of Metals.

No. II.*

IN the absence of the authors, a paper by Messrs. H. Waterhouse and R. Willows, of which we give the official summary below, entitled "The Effects of Cold-rolling and of Heat Treatment on Some Lead Alloys," was presented by Dr. Moore.

COLD-ROLLING AND HEAT TREATMENT OF LEAD ALLOYS.

The effects of cold rolling, heat treatment and storage on the Brinell hardness of fourteen lead alloys containing small additions of tin, cadmium, and antimony have been studied. The hardness numbers of the cast alloys ranged from 5 to 18 Brinell. Cold rolling hardened the soft alloys and softened the hard alloys, the hardness immediately after cold rolling lying in all cases between 8 and 11 Brinell. Self-annealing at atmospheric temperature further reduced the hardness to about 7 Brinell.

Most of the alloys, especially those containing cadmium and antimony, were rehardened to approximately the "as cast" hardness by suitable heat treatment, quenching, and ageing. Certain alloys age hardened after air cooling or even more restrained cooling from the heat treatment temperature. The age hardness persists for several months at least, but is destroyed by severe cold working and self annealing. The hardness of the harder alloys "as cast" is largely due to age hardening. An alloy containing 1·5 per cent. cadmium and 0·5 per cent. antimony is particularly susceptible to age hardening.

* No. I. appeared September 18th.

Mr. Kenneth Gray said that the lead-cadmium-antimony was substituted for ordinary lead for the sheathing of electric cables on account of failures which occurred with the higher tension currents, and had so completely overcome the trouble that all electric cable now ordered by any Department of the British Government was specified to be sheathed with these alloys. The alloy in itself was expensive, but it had remarkable tensile strength, so that 1 ton of it went 50 per cent. further than lead. Another point was that these alloys offered a very much greater resistance to the solvent effect of certain waters, and it was a step in the right direction that they should be used instead of lead in such circumstances for water supply. Two other qualities of the alloy which were of great value were that it was more easily worked by the plumber. It was very strange that the differences should be so marked between the alloy and lead, particularly when it was remembered that the alloy contained 99·25 per cent. of lead in many cases.

Dr. H. F. Moore said he wished to bring out one or two corroborative facts to the paper based upon experiments on lead sheath for high-tension cables, which were under way at the University of Illinois. When one spoke of the tensile strength of either lead or lead alloys, the time in which the test was made had to be observed. The tensile strength could be enormously changed by making the test more slowly. Lead which would stand under a very slow tensile test—with a strain perhaps of 1/100th of an inch per gauge length per minute—at 2400 lb. per square inch, would show very definite signs of continuous creep at as little as 400 lb. per square inch. They had not studied the cadmium alloys, but in the calcium alloy, and in the alloys of antimony and tin there seemed to be a very well-marked tendency in that matter of creep, for all alloys to behave very much alike.

A paper entitled "The Protection of Magnesium Alloys Against Corrosion," by Messrs. Sutton and Le Brocq was then presented. The official abstract runs as follows:—

MAGNESIUM ALLOYS AND CORROSION.

In this paper the various methods of protecting magnesium alloys against corrosion are considered. Of the methods examined the most promising appeared to be that of chemical treatment of the surface followed by the application of lanolin or a suitable enamel. Two chemical processes have been developed which afford very fair protection, viz. (1) immersion for six hours in a bath containing 1½ per cent. potassium dichromate, 1 per cent. alum, and ¼ per cent. caustic soda, the bath being maintained at 95 deg. Cent.; (2) immersion under the same conditions in a bath containing 1½ per cent. potassium dichromate and 1½ per cent. sodium sulphate (decahydrate).

For surfaces which are in the "as cast" condition, a preliminary cleaning treatment in 10 per cent. nitric acid is necessary, but for parts machined to fine tolerances this method is too drastic. In such cases a solution of 2 per cent. caustic soda is used. Sand-blasting as a preliminary treatment is not recommended.

Mr. W. H. Ziegler said it was important from the point of view of corrosion whether the magnesium was in the form of a solid solution or a heterogeneous structure, for the solid solution had an excellent resistance to corrosion, whereas the heterogeneous structure was very much less resistant. Chemically treated, or chromic acid treated, magnesium alloy did not resist really severe conditions of corrosion, especially from sea water. Therefore, enamel protection was used for any casting or other piece of magnesium alloy which was continuously exposed to atmospheric agents. He had found that very few varnishes, especially cellulose varnishes, gave a good adherence to magnesium alloys. A titanium pigment might be used in the priming coat, prepared in oil, or, if it was practical to use it, some enamel which was heat treated—such as synthetic resin or asphalt varnishes—which gave a most perfect protection.

Dr. Meisner asked the authors if they could give any information about the use of British patent specification No. 305,544 of 1929, which claimed a process for protecting magnesium and magnesium alloys by a coating of pure aluminium or an aluminium alloy, as, for example, an aluminium-silicon alloy.

Dr. Rosenhain said he thought that magnesium oxide, as a coating, was fairly hopeless, and some other compound of magnesium which might be formed on the surface and which was more resistant and gave a more continuous film, must be found, or the principle of alloying must be applied to the surface film as it was to the metal itself. If, instead of producing a film of MgO, a mixed oxide film or a mixed hydrate film could be produced—for instance, by reaction with aluminium salt so as to get a mixture of MgO and Al_2O_3—in such a form as to give a film related to the basic metal by its content of MgO and to some extent sharing the properties of the aluminium film, a good deal of progress might be made. That was only a very rough suggestion, but perhaps it opened up a line of investigation which, so far as he knew, had not yet been attempted. Continuing, he said that fluorine was probably the most chemically active body known, and there were very few substances which would resist it. Magnesium was one, apparently, of them. It did so by coating itself with an inert layer of magnesium fluoride, which prevented all further attack of fluorine gas upon the metal. That appeared to him to indicate another direction which research might take.

Mr. Evans deemed it important, in connection with the corrosion of magnesium, to remember that there were there two quite distinct types of corrosion. If magnesium was deeply immersed in a chloride solution, it produced quite a lot of hydrogen, and corrosion of the hydrogen evolution type resulted. The rate of that corrosion depended very much upon the over-potential value of any second metal which was present. On the other hand, when magnesium was exposed in the presence of an excess of air to spray, corrosion of the oxygen absorption type occurred, and there the over-potential value of the second constituents was not particularly important. Consequently, in studying the effect of the composition of these alloys, it was necessary to distinguish rather clearly between the conditions to which the material would be exposed in service. He was a great believer in aluminium as a protector. In some experiments, quite in the early stages, on protection of iron by aluminium coats or aluminium alloy coats, the results had been rather hopeful. Here the difference between iron and magnesium was very marked. Speaking generally, aluminium was anodic to iron, and one could have quite a big gap in an aluminium coat and spray it with salt water, and yet the iron would remain quite unrusted, whereas with any gap in an aluminium coat on magnesium a serious attack on the magnesium underneath resulted. Treatment on aluminium film by the anodic process in chromic acid was, on the whole, likely to make matters worse, even if it could be applied. It would seem therefore that a rather more hopeful proposition would be to fill up the pores with some substance of a resinous nature. One point to be remembered, however, was that aluminium coats in which the pores had been filled up with synthetic resins were definitely more brittle, and were more likely to break away if the article were bent, than when the aluminium coat was not so filled up. He said that he was very interested in the question of protection by chromates, particularly because it appeared to be a case where a thicker film gave better protection than a thin film.

Dr. R. S. Hutton said that if a self-healing film was being sought as the ideal protection for magnesium, surely the right thing was to produce it from the body of the magnesium alloy itself, and with some material in the corroding medium that was commonly there, and was likely to be always present. In most of the practical magnesium alloys there was a considerable percentage of aluminium—much more than enough to form films of the order of 1 to 10 or 20 molecules thick. He thought that very shortly something which did not need to be present to any very appreciable extent, expressed in percentages of the alloy constituent, might be found. Something perhaps of the

order of 1/100th per cent. of the constituent might be sufficient to give the basic means of future development.

Mr. Sutton replied briefly.

Mr. Griffiths then presented a paper on "Nickel-Copper Alloys of High Elastic Limit," by Messrs. Jones, Pfeil and Griffiths. The official abstract is given below.

NICKEL-COPPER ALLOYS.

The investigation recorded in this paper was undertaken primarily in order to obtain reliable values for the elastic limit of nickel-copper alloys containing up to 50 per cent. of nickel, but determinations were also made of maximum stress, elongation, and reduction in area. It was found that the elastic limit is low in substantially pure nickel-copper alloys in the fully annealed and in the cold-drawn conditions, but that high elastic limits are developed in all compositions as a result of low-temperature heat treatment following cold working. High elastic limits may also be produced in nickel-copper alloys containing small amounts of such elements as silicon, which render the alloys susceptible to heat treatment.

By a combination of the effect of cold work and low temperature heat treatment with the effect of precipitation hardening, high elastic limit material may be produced with greater facility than by either method alone, whilst good combinations of mechanical properties may be developed by suitable compositions and treatment. With higher contents of silicon a certain amount of difficulty is met with in some production operations, but even with less than 0·25 per cent. silicon exceptionally good properties can be obtained, and the alloys of this composition present no difficulty in manufacture.

Mr. W. R. Barclay said that the paper seemed a very suggestive piece of work. Hitherto, these nickel-copper alloys had been regarded as having special applications, and their more general application had not been visualised. Material which combined a high elastic limit with a tensile strength of 40 tons and appreciable ductility obviously offered possibilities in engineering industry.

Dr. H. Moore said he believed that silicon alloys were entirely free from any susceptibility to season cracking, and he asked the authors if they had come to that conclusion. If that was so, it might give those alloys a very considerable advantage over the high-tensile brasses.

Mr. W. E. Alkins, interjecting, said he had met with season cracking in silicon copper, and also in an alloy containing copper-nickel and silicon. He was speaking of alloys with only low nickel.

Mr. Pfeil, in his reply, said that the work was carried out and continued owing to the indications that there was a hopeful outlook for the alloys in engineering work. They hoped to go on with the nickel-copper alloys for other considerations, and also, perhaps, try the duplex method of getting high elastic limits. After low-temperature heat-treatment, the alloys were quite free from season cracking, but he would go so far as to state that in connection with alloys which were not low-temperature heat-treated.

A paper entitled "Unsoundness in Aluminium Sand Castings" (Parts 1 and 2) was then presented by Professor Hanson.

ALUMINIUM SAND CASTINGS.

The presence of water vapour in contact with molten aluminium or its alloys leads to the production of "pin-holes" in sand castings of the metal. A comparison has been made of various methods of treating the molten metal prior to casting, with a view to eliminating such pin-holes. The methods investigated include some previously proposed by other workers, as well as a number not previously used. Treatment with nitrogen or with chlorine is sometimes successful, but cannot always be relied upon to produce castings perfectly free from pin-holes. Titanium tetrachloride is effective with "Y" alloy, but was found to be less certain with other alloys, although the grain refinement which it produces may make the pin-holes very small without reducing the total volume of the cavities. The most generally successful method was found to be treatment with a mixture of equal parts of nitrogen and chlorine, by means of which all the alloys examined could be made practically sound by a treatment of 20 minutes' duration at 700 deg. Cent.; 60 lb. melts of "3 L 11" alloy were successfully treated at 730 deg. to 750 deg. Cent. on a works scale, but difficulties were experienced with 300 lb. melts of "3 L 11" and "2 L 5." The success of all gas treatments depends on the temperature of the molten metal; just above the liquidus most of the methods proposed are very effective, but if the temperature of the metal is much above 700 deg. Cent., it is doubtful if any method so far proposed can be relied upon to give successful results.

Treatment with volatile constituents such as sulphur, selenium, tellurium and cadmium has been tried with varying results. Superheating "2 L 5" alloys to 950 deg. Cent., prior to casting at normal temperature greatly reduced the number of pin-holes.

It is found that virgin aluminium after exposure to suitable corrosive conditions and subsequently sand cast, is unsound and contains pin-holes. Alloys of aluminium including "3 L 11," "2 L 5," "Y," and 12 per cent. silicon show a similar phenomenon. The extent and amount of unsoundness which is produced depends upon the type and time of exposure, and also upon the particular alloy examined.

The suggestion is made that the deterioration is the result of electrolytic action on corrosion, involving the liberation of hydrogen in the nascent state, which is absorbed by the metal. On remelting and casting, the hydrogen is evolved in the molecular condition and produces pin-holes.

Dr. Zeerleder discussed the *rôle* of moisture and hydrogen in producing unsoundness. Unsoundness, he said, was observed not only in pure aluminium as used for ingot casting, but also in the alloys. It was a well-known fact that aluminium melted in moist weather in open-hearth furnaces, or in a newly built-up furnace, even if it was carefully dried, tended more to porosity than the same metal melted in dry air, or in a furnace that had run for a long time. The most important thing in the papers was the recommendation that foundrymen should be very careful in storing their metal to avoid all corrosion of it before it was used. He believed that much further work had to be done in investigating the possibilities of the influence of hydrogen on the porosity of metals.

Dr. A. G. C. Gwyer said he did not think many people would dispute that dissolved gas was the principal factor which caused pin-holing, or that hydrogen was probably the most dangerous gas. Solid solubility, however, was less in alloys, especially the copper alloys, than in the pure metal, and, therefore, he was certain that the authors were right in studying the copper alloy rather than the pure metal. He was very much impressed by their method of revealing the soundness by contact prints. For a large-scale work, he was inclined to think that this was the best method of studying the differences in pin-holing, especially when the differences were very large; but when it was desired to deal with smaller differences, then he preferred to rely on density measurements. It had, however, this practical drawback, that a large number of chemical analyses became necessary. With regard to the various treatments to which the authors had subjected their metal, especially from the point of view of improvement—nitrogen, nitrogen plus chlorine, and so on—he confirmed what they said, namely, that nitrogen was not much good in ordinary circumstances. Titanium tetrachloride, certainly when applied at low temperatures, was very successful in degasifying, and improvements resulted owing to grain-size refinement. He thought it possible that grain-size refinement might be of great importance even to founders, because if the pin-holes were very small indeed, they did not affect the tensile strength and probably, from the founder's point of view, did no harm at all.

Mr. Mortimer said that, first of all, he would like to make it rather clearer than it had been made, that aluminium castings were not normally full of pin-holes like a pumice stone. Summing up the practical effects of the research so far, he gave as an example that, if about two years ago, one got an order for very big Diesel engine pistons, one went about rather like a cat on hot bricks wondering whether he was going to produce the pistons all right. One did in the end produce about two good ones for ten bad ones, because it was a very big test for metal to pour it into a casting weighing about 800 lb. in sand with sections 4in. thick in Y alloy, and then to allow the customers to machine it down, and to get no pin-holes whatever in it. That was a very big test. That work could be done to-day absolutely with precision. This question of degassing was essentially one for the founder and not for the producer. When a melt of 10 tons had to be dealt with, the time that one would have to give to blowing gas through could be imagined. It had been compared with Bessemerising. But in Bessemerising one took a relatively low grade product, blew through it some very cheap air, and then obtained a product which could be sold at a higher price. In the case of degassing aluminium, it was necessary to blow through it a gas, or a combination of gases, which would certainly bring one into trouble with the neighbourhood and with the Health Department, and in the end a lower quantity of exactly the same priced material was obtained. Therefore he thought that that was fundamentally a question for the founders to deal with in small melts. The practicability of dealing with large melts was still remote.

Dr. Rosenhain said that the question of the use of a mixture of nitrogen and chlorine was very interesting. The only difficulty was that it was not very much easier to use than chlorine by itself—and equally objectionable from many points of view. The authors themselves described how their tubes were either plugged up or corroded away. That trouble could be overcome by the use, not of a mixture of nitrogen and chlorine, but a mixture of nitrogen and the vapour of a volatile chloride—either titanium tetrachloride or carbon tetrachloride. The action of that mixture appeared to be very similar to the action of nitrogen and chlorine, and it was much more convenient to handle. He was inclined to think that, ultimately, the prevention of hydrogen, rather than its removal, should be the aim of metallurgists. That was a difficult problem—difficult not so much for the founder as for the producer. A solution was not to be expected in a day. Meanwhile, the processes of gas removal did furnish means of producing the desired result, if and where it was necessary, and sufficiently worth while.

If the interpretation of the results in the second part of the paper was true, then something of really fundamental importance had been secured; but he ventured to doubt whether the evidence yet produced established that interpretation, and he asked if it had occurred to the authors to take a fairly thin sheet of aluminium, allow it to corrode on the surface, and then mechanically remove the products of corrosion before re-melting. If, in re-melting under those conditions, they still found the metal more gassy than similar material which had been protected from corrosion throughout, he would feel inclined to accept their conclusions. The matters raised in the paper were of very great importance, and should be followed up very thoroughly, because the suggestion that corrosion was of importance as damaging the bulk of the metal if the metal was of any considerable section was very startling. If it was true, it would mean a very great deal to industry to guard against it. It was no simple matter for the foundryman to keep his metal under cover, and if aluminium ingots had to be stored like sodium under paraffin, it was going to be a decided inconvenience.

The President said that he had had the privilege of discussing the matter with Professor Hanson on several occasions, and had always urged him to devote as much time as his means allowed to establishing the fundamental scientific facts of the matter. There was one small point in the paper on which he might touch. Professor Hanson made it a *sine qua non* of his hydrogen absorption views that liquid water should be present. He took the view that gaseous water, so long as it was not condensed, would not bring about the corrosion which he feared, and, consequently, not give rise to the absorption of hydrogen. He, the President, knew of one communication which had any bearing on that subject, and that was one by Guillet, and some of his collaborators, who examined the effect of superheated steam on aluminium. In their paper they described the deep-seated corrosion of all the alloys they tested, and the one which suffered most was the super-pure aluminium which we get to-day—which simply disappeared. Mr. Williams and he re-examined that phenomenon, but were totally incapable of repeating the results obtained by Guillet. They had not, so far, found any attack at all by superheated steam. Probably, it was of some importance to establish that fact, and he hoped on some future occasion to present a note on the subject.

Professor Hanson, in reply, said that so many points had been raised that he could not reply to them in detail now; but there were two matters which he thought he might mention in general terms as arising out of the papers and out of the discussion. The first was in regard to the practical application of those processes of degasification. He wished to make it quite clear that in putting those processes before the meeting they were not recommending any one of them as a really generally suitable practical method of degassing aluminium alloys; all of them had certain practical difficulties. The other point was the question of the theoretical part of the paper, which they put forward tentatively and with a considerable amount of caution; but they felt that the results were so important and striking that they ought to offer something in the way of explanation. Although it was not dealt with in this paper—which was of a preliminary nature—they found the explanation of Dr. Zeerleder—to which Dr. Rosenhain also referred—unsatisfactory. They had taken these exposed ingots and had cleaned off all the corrosion product they possibly could; in some cases they had pickled them, and had left them, as far as they could, dry, or free from corrosion product, and still they found deterioration present in the metal. Furthermore, they had just completed an experiment in which they had allowed chemical attack to take place on one side of a thin sheet of metal, and had collected the hydrogen in quite considerable volumes from the other side. There was no doubt in their minds that the hydrogen resulting from chemical attack could at least get into the metal and even get out on the other side.

A paper entitled "Applications of the Electric Furnace for Non-ferrous Metals, with special reference to the Bright Annealing Process," by H. C. Kloninger, G. Keller and H. Meuche, was then read.

In this paper are briefly described the main types of furnaces used to-day for the bright annealing process. It is shown that during the past few years considerable improvements have been made in the quality of the product as well as in simplifying the handling of the annealed metals.

There was no discussion. A paper on "The Macro-etching of Aluminium-silicon Alloys," by William Hume-Rothery, M.A., Ph.D., Member, was then taken.

THE MACRO-ETCHING OF ALUMINIUM-SILICON ALLOYS.

The author says that the macro-structure of aluminium-silicon alloys can be revealed satisfactorily by means of a solution of cupric chloride containing from 150 grm. to 160 grm. per litre. Etching is carried out by immersing the specimen several times in the copper-chloride solution, the deposit of copper being removed between each immersion. A final brightening can be obtained by treatment with a dilute solution of chromic acid. The preparation of the specimen, and the details of the etching process are described, and have been tested for alloys containing 5, 10, and 11 per cent. of silicon respectively.

There was no discussion.

The last paper taken on Monday was entitled "Note on the Failure of a High Strength Brass," and was by Messrs. Newson and Wragg. The official summary says:

THE FAILURE OF A HIGH STRENGTH BRASS.

It has been determined by the author that the reeling process for straightening, after extrusion, in the case of a brass with a high yield point, is responsible for residual stresses of such an order that failure due to internal cracking may result during storage, or on subsequent machining. The stresses are tensional, decreasing in intensity from the centre of the bar to the circumference. Suitable low-temperature annealing treatment effectively removes all possibility of residual stress cracking.

The only speaker in the discussion was Dr. H. Moore, who called the authors' attention to a paper issued from the Research Department at Woolwich in 1923—a paper by Mr. Beckinsale, entitled "Studies in Season Cracking and its Prevention."

(To be continued.)

A COVERED reservoir is to be erected on the historic Plains of Abraham battlefield for the City of Quebec, Canada. The contract for the construction of the 30-million-gallon structure has already been let.

Automatic Train Control on the Southern Railway.

AUTOMATIC train control is primarily a means for advising a driver whether the distant signal he is approaching indicates "warning" or "clear," and then, if at "warning," if the stop signal which he will reach 600 or 800 yards further on is at "danger" or "clear." It is, secondarily, a means whereby the continuous brake is automatically applied and the train pulled up should the "warning" indication given by the distant signal be ignored; should the brake subsequently be released by the driver in order that the train may proceed up to the stop signal a similar warning and a renewal of the brake application is given there so that the train is definitely stopped. In some cases a ramp, actuated by contact with a shoe, is employed, but in the system about to be described actual contact is replaced by magnetic induction.

The inventor, Mr. A. E. Hudd, is an Englishman and a railwayman. He was a premium apprentice of Sir John Aspinall at Horwich, and was on the Liverpool and Southport electrification, having charge of the mains under Mr. H. E. O'Brien. Thence he went to Victoria in connection with the electrification of the Melbourne suburban railways, but subsequently returned to England and, becoming interested in automatic train control, went to the United States to study the question. We make that explanation because the owners of the Strowger-Hudd system are the Automatic Electric, Inc., of Chicago, but all the plant is British made, having been manufactured by the Automatic Telephone Manufacturing Company, Ltd., of Liverpool.

The first trials of the system were made in this country at Wraysbury, on the Staines and Windsor branch of the Southern Railway, a tank engine being fitted with the cab equipment. They proved satisfactory within their limits, but to gain further experience an installation has been laid down on the up through line at Byfleet on the main line and the 4–6–0 tender engine No. 774, "Sir Gaheris," of the "King Arthur" class, has been fitted. Speeds of up to 78 m.p.h. have been made over this length in regular service and have shown that the apparatus is quite immune from the effects of vibration and shock.

In the Strowger-Hudd system permanent and electro-magnets are used to operate "receivers" carried by the locomotive, which cause a whistle to be blown and the continuous brake to be applied as required. The receivers are actuated by inductors, of which there are usually three. What is known as an A Inductor is placed some 200ft. in the rear of the distant signal. A view of the underside of one is shown in Fig. 1. It consists of permanent magnets lying at right angles to the direction of travel. It is continuously energised and its effect is to allow a slight release of the vacuum in the train pipe so that a hooter is sounded to intimate to a driver that he is at a distant signal.

At the "distant" is Inductor B—see Fig. 3. It is an electro-magnet and lies parallel to the rails and is normally unenergised, but is connected electrically to a primary battery which is switched in on the train entering on to a length of 135ft. or so of track circuit should the distant arm give the "clear" indication. When thus energised Inductor B undoes the work performed by Inductor A and restores the "receiver" to its original state. Hence the driver, by getting no further whistle and no brake application, knows that the signal is in his favour. Attention may here be drawn to the fact that energy is necessary to give a "clear" signal; the absence of energy—owing to failure of the track circuit or the battery, or to the inductor being damaged—would lead to the application of the brake.

At the stop signal Inductor C is fixed. It, as will be seen from the underside view, Fig. 2, is a combination of permanent and electro-magnets. The latter, as in Inductor B at the distant signal, are controlled by the condition of the stop signal and, when energised, overcome the effect of the permanent magnets. Thus, if the signal is at "danger" the permanent magnets are in full play and cause the brake to be applied and the hooter to sound; if the signal is at "clear" the electro-magnets are energised and the effect of the permanent magnets is negatived so that no brake application is made nor hooter sounded and the driver knows that he has a "clear" signal. As will be understood, should the distant have indicated "warning," the driver would be approaching the stop signal cautiously. Colour light signals control the inductors through their own control circuits.

The receiver on the locomotive—Figs. 5, 7 and 8—is carried on an attachment made to the lifeguards and there is a clearance of 4in. between it and the inductors and of 5in. between it and rail level. The latter is thus an inch in excess of the minimum of 4in. laid down in the recommendations of the 1927–1930 Automatic Train Control Committee. It consists of four collector plates A A, B B, with their respective pole pieces A^1, A^2, B^1, B^2. Pivoted at D is an armature C having a spring blade E which covers the pilot valve in a rubber hose connection O to the train control valve in the cab of the locomotive. The armature normally has two arms in close proximity to the

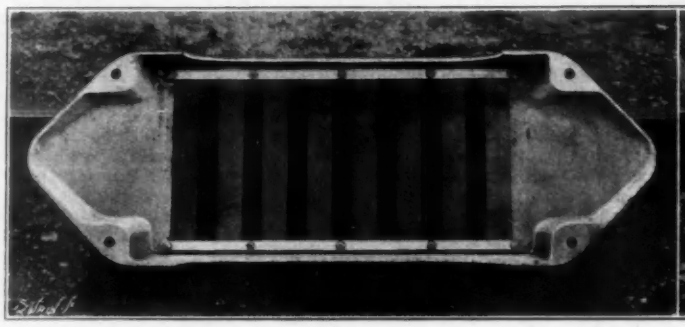


FIG. 1—A. INDUCTOR—UNDERSIDE

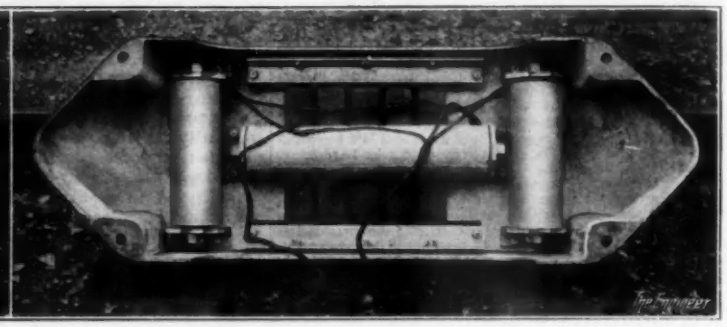


FIG. 2—C. INDUCTOR—UNDERSIDE

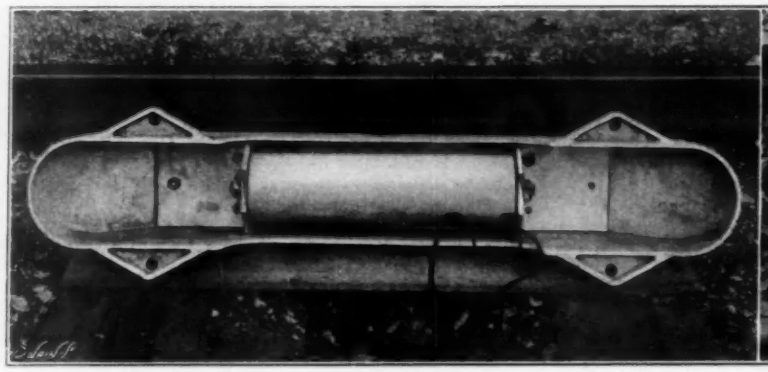


FIG. 3—B. INDUCTOR—UNDERSIDE

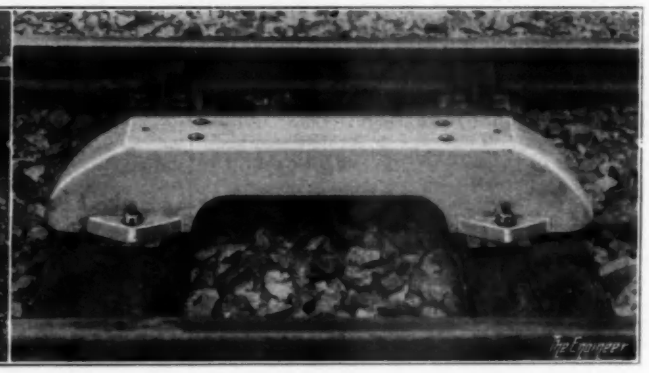


FIG. 4—B. INDUCTOR IN TRACK

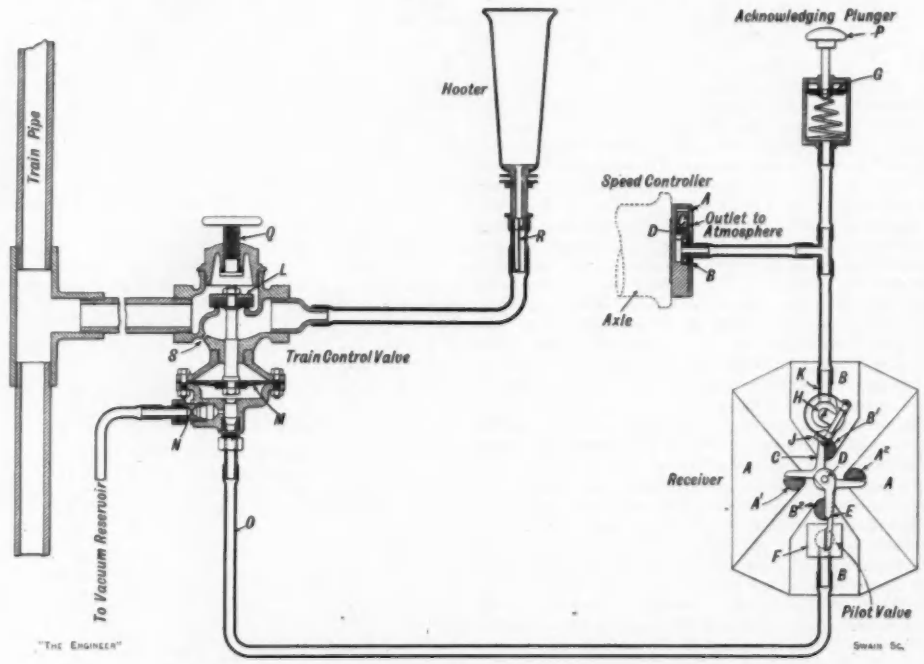
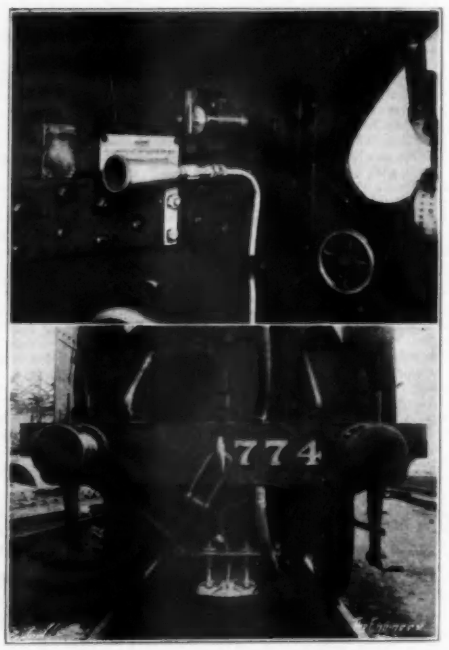


FIG. 5—STROWGER-HUDD AUTOMATIC TRAIN CONTROL SYSTEM



FIGS. 6 AND 7—EQUIPMENT ON THE ENGINE

pole pieces B^1 B^2 and the other two arms away from A^1 A^2.

The train control valve in the locomotive cab has a valve L which is normally held on its seat by the diaphragm M, behind which a constant vacuum from the vacuum reservoir on the locomotive is maintained through a restricted orifice N. When the valve L is released a portion of the incoming air operates the reed R of the hooter and the remainder enters the train pipe and makes a gradual application of the brake.

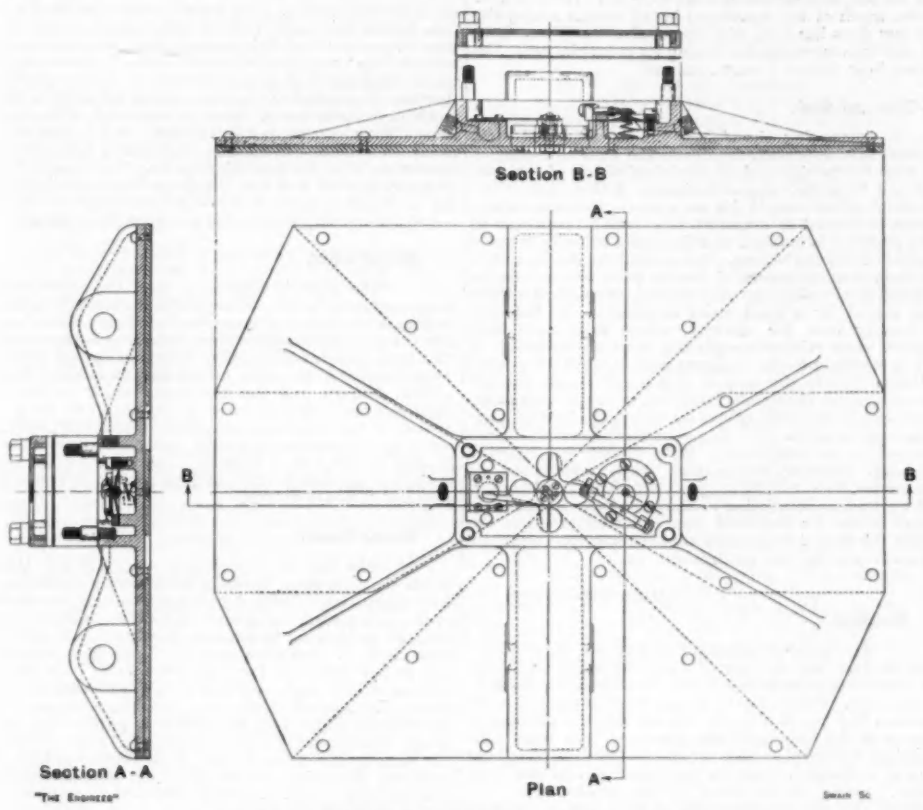


FIG. 8—RECEIVER OF STROWGER-HUDD SYSTEM

With the receiver in the normal condition the locomotive, when approaching a distant signal, will pass over inductor A, which will throw up a magnetic field at right angles to the direction of travel, so that plates A A are energised. The armature is therefore attracted to pole pieces A^1 A^2 and away from B^1 B^2 and the pilot valve is opened. The area uncovered is approximately twice the size of the inlet through the orifice N, and thus the valve L is released so that the before-mentioned sounding of the hooter is given and a slight reduction of vacuum is made in the train pipe.

The driver is thus warned that he is at a distant signal and the locomotive at once passes over inductor B. That, as has been shown, is controlled by the indication given by the signal and its magnet is not energised if the "warning" indication is given. The brakes will then continue to be applied and the hooter to sound. If, however, the magnets are energised the plates B B pick up the current, the pole pieces B^1 B^2 attract the armature and the pilot valve is closed, so that there is no further brake application nor sounding of the hooter.

Should the driver have been warned at the distant he will proceed cautiously up to the stop signal and inductor C. If that signal indicates "danger" the permanent magnets cause pole pieces A^1 A^2 to attract the armature and for the train control valve to be opened; if, however, the signal indicates "clear" the electro-magnet in inductor C is energised and pole pieces B^1 B^2 hold the armature and prevent the pilot valve from opening.

It is, of course, necessary for the driver to release the brake, after it has been automatically applied, in order that the train may run forward to the home signal, and to stop the hooter. That is done by the plunger P—seen above the hooter in the illustration of the interior of the cab—attached to the piston G, which acts on diaphragm H and operates the rocker shaft and arm J so that the armature is restored to its normal position against pole pieces B^1 B^2. To prevent any possibility of continuous operation of the diaphragm H a small leak hole is provided at K. The plunger is at once reset, when released by the driver, by means of the spring under the piston G.

Experience in the United States has shown that evils may result from premature use of the acknowledging plunger, known there as a forestaller. To overcome that the Strowger-Hudd arrangement has had added to it—though not as yet at Byfleet—a speed controller A running on ball bearings B, attached to the axle of, say, the leading wheel of the bogie. When the speed has been reduced to 25 m.p.h. or less the weighted valve C closes the outlet D and allows the plunger to be used; at speeds over 25 m.p.h. the valve C is kept open by centrifugal force and the operation of the plunger is of non-effect.

It is obvious that this addition can be utilised for speed control over curves wherein an inductor of the A type requiring no current will automatically apply the brakes at a given point and keep them applied until the train has been brought down to a predetermined speed.

Provision is made for non-interference with the inductors on lines equipped with a third rail for electric traction and for the control of trains using the Westinghouse brake.

Two important features are obvious. The first is that at every distant signal the driver gets an intimation as to whether the signal arm is in the "warning" or the "clear" position, also the assurance that the apparatus is functioning correctly. The second is that, in foggy weather, when he cannot see the line before him, he will, after the "warning" indication at the distant, close his regulator, get his train under control, and drift towards the home signal. There, 60ft. in the rear of that signal, he passes over inductor C, and is told whether or not he may proceed. That, at junctions and other important points, is a great aid to safety, and, moreover, economises time. Should the driver have had a clear intimation at the distant he knows that he can proceed in the assurance that the stop signal is "off."

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Trade Situation.

THE uncertainty of the future and the national commotion of the past week has provided a further occasion for the holding back of business, and fear and indecision have prevailed throughout the week in Midland and Staffordshire iron and steel circles. It must be frankly admitted that the plight of the basic industries in this area is growing more acute, the volume of orders coming to hand is declining, consumers are asking for the suspension of deliveries, and in some branches—notably that of pig iron—it would appear that further curtailment of output will be necessary in the very near future if supply and demand are to be balanced. On 'Change in Birmingham this week very little business was transacted. Orders were scarce in every department of the market, and even sellers' offers to shade prices of uncontrolled materials met with no response. Home and export business is similarly affected, and the seriousness of the overseas position is shown by the fact that for months past imports have exceeded exports on a tonnage basis. Official returns show that in the eight months of this year imports of iron and steel have amounted to 1,709,714 tons, while exports amounted to only 1,311,671 tons. Whether one looks to the home or overseas markets, the outlook is not encouraging. Engineers fear the countermanding of development schemes provisionally sanctioned, and they are accordingly holding off the market, buying no more iron and steel than is required for immediate use. Everyone, of course, realises the urgent need for economy, but it is thought that Midland engineers in many branches of trade will be hit very hard. Activity at the works in this area has been more restricted this week, and producers of iron and steel and of manufactured goods are finding it exceedingly difficult to keep plant in operation.

Raw Iron.

Despite the recent small increase in the buying of pig iron, the market for this material is not bright, for production continues in excess of demand, and there is talk of further curtailment of output. Notwithstanding the dismantling of many blast-furnaces since the war, there are still in existence 394 in England, Scotland, and Wales, but 324 of them were out of action when the last returns were made, and a further probable decrease in the number of active furnaces is foreshadowed. The forgemen and foundrymen in this area are not receiving the support customary at this season of the year, and this reacts upon the raw iron trade. One or two foundrymen believe that there are now indications of an improving demand, and they have made inquiries at the blast-furnaces regarding forward supplies. Very few contracts have, however, actually been entered into with Midland smelters as yet. The cast iron pipe foundries are consuming fair quantities of Derbyshire pig iron, and smelters in that area are just about able to find a market for that portion of their production which is not taken up by these firms. Northamptonshire blast-furnacemen are not so well placed, and though they keep output down, they are adding to stocks weekly. It is, indeed, fortunate that foreign pig iron is not competitive in this area, for as it is local smelters are assured of getting all the available business. The growth of the use of foreign pig iron in districts nearer the coast is, however, commented upon here. Recent statistics show that even on the shrunken basis of trade this year, with consumption falling all over the world, we have imported 72,774 tons of forge and foundry pig iron in eight months, as compared with an importation of 47,177 tons in the twelve prosperous months of 1913. Northamptonshire smelters who compete to some small extent with the foreigner in Northern markets are still meeting with success, but they have to accept orders at prices which leave little, if any, margin of profit, and which, of course, could not be accepted in this district where selling prices are controlled. The Pig Iron Producers' Association maintains the recent level of selling prices at:—Derbyshire: No. 3 foundry, £3 6s.; forge, £3 1s. Northamptonshire: No. 3 foundry, £3 2s. 6d.; forge, £2 17s. 6d.; and North Staffordshire: Foundry £3 6s.; forge, £3 1s.—all per ton delivered to stations in the Black Country and subject to rebate in the case of very large users.

Steel Prices.

There is a smaller call for finished steel at the moment. Midland constructional engineers are moderately employed, but the outlook is uncertain, in view of the necessity for economy, which may result in the postponement of schemes. The calling of the Steel Manufacturers' Association meeting a month in advance of the quarterly conference, excited some speculation. Presumably the question of prices was to come under consideration, for there has been a good deal of discussion as to the effect on business of the scale which was laid down about the turn of the year, and has been in operation since. It was hardly expected that in the circumstances the present price basis would be disturbed. Steel masters contend that there is very little profit to be made in the industry to-day. However, it has been urged by consumers for some time past that the control was being used to make British steel too expensive. The question was specifically raised in connection with steel for shipbuilding. The Association decided to maintain prices on their present level. In the Midland area they are £8 7s. 6d. for angles, £8 15s. joists, £8 17s. 6d. plates, with rebates of 15s. on angles and plates, and 22s. 6d. on joists to customers who agree to use British steel only. Midland structural engineers appear to be convinced that the need of economy is almost certain to result in the postponement of schemes which would have gone forward with the assistance of Government grants, but which will not be pursued without the grant. Boilermakers in this area are but moderately engaged, and boiler plate quotations are easy at £9 per ton. In the half-products branch the market is very unsettled. The demand made upon the Government to impose an import duty has had the effect of further upsetting buying. One would almost have expected some stimulation of demand for foreign material, particularly as so much of it is being used in Midland and Black Country works just now. Such has not, however, proved to be the case. There has been no buying movement of note up to the present. Many of the works have bought fairly well, and have considerable stocks, for they have not used up their raw material as quickly as they had anticipated when they bought it. Neither has there been any improved call for native semis. Small bars rolled from foreign billets were quoted £6 7s. 6d. and all-British bars £7, while quotations for mild steel billets range upward from £4 17s. 6d. per ton. Staffordshire hoops command £9 10s. delivered.

Finished Iron.

There has been no change on the week in the conditions existing in the Staffordshire finished iron trade. The struggle for orders is unabated. Only a few works are operating, and they can only work continuously for a few days each week. There are one or two exceptions, where producers of best grade bars are able to put in a five-day week. Orders are small in size and need constantly to be replaced. Prices stand unchanged at £12 a ton at makers' works for marked bars. Weakness is a feature of the market for Crown iron, but the list figure is about £9 5s. Competitors from other districts are keen for Black Country business, and they do not hesitate to meet buyers in the matter of price. Nut and bolt and fencing iron is quoted at £8 7s. 6d., but very little business is passing. Small specifications are being received for wrought iron gas tube strip, but values remain shaky, quotations varying between £10 10s. and £10 12s. 6d. per ton delivered. Inquiries for iron scrap are very scarce and prices are lower than for years past.

Galvanised Sheets.

Galvanised sheet prices continue to depreciate, the minimum selling figure for 24 gauge corrugateds having declined to £8 15s. per ton f.o.b. Some mills quote £9 per ton, and there are numerous producers who refuse to do business at the new minimum. The collapse of prices since the removal of control early this year has been very marked, and present values are held to be unremunerative. Under these circumstances, there is talk of a renewal of concerted action for price control. At the usual manufacturers' meeting a week ago the question is said to have been discussed, but no definite action on the lines indicated appears to have been taken. A few orders from overseas are reaching this district—indeed, they continue to show an improvement—but the mills are so poorly supplied with business that they are unable to prevent the decline in values. Even for home consumption, mills short of orders are willing to make price concessions. Tonnages

are lighter than is usual, and a large number of orders is required to enable mills to make regular production. West Indies and South America are buying more freely, but apart from a few small orders there is little expectation of trading with the Indian market, which at one time provided local mills with so much employment.

Droitwich Sewerage Scheme.

Droitwich Town Council has accepted the tender of the Provincial Construction Company, Wetherby, Yorkshire, at £28,000, for carrying out a sewerage scheme for the borough. The tender was the lowest of eight received—the highest being £32,500—and was recommended by the Council's engineers, Messrs. Wilcox and Raikes, Birmingham. The tender was accepted provisionally upon the consent of the Ministry of Health being received.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Through Run from Manchester to Budapest.

AN outline is available of the plans which have been elaborated by the London and North-Eastern Railway Company for the transport of the large order for electric locomotive and other railway electrification material placed by the Hungarian State Railways with the Metropolitan-Vickers Electrical Company, Ltd., Trafford Park, Manchester, which company is now busily at work on the contract. The total weight of the material will be in the neighbourhood of 1400 tons, and consignments will be made as portions of the contract reach completion. The material will be loaded at Manchester on to specially designed well-trolley wagons, of a carrying capacity ranging from 20 to 110 tons. Transport history will be made by the London and North-Eastern Company, for, in its journey to Budapest, a distance of something like 1200 miles, the additional expense and risk associated with the transhipment of machinery at ports will be avoided. On reaching Harwich the vehicles will be taken to Zeebrugge by train-ferry, and will then go direct *vid* Belgium, Germany and Austria to Budapest, for employment on the 80-mile stretch of the electrified line from that city to Komárom.

New Coal Research Headquarters.

The new research laboratories of the Lancashire and Cheshire Coal Research Association at Park-street, Cheetham, Manchester, were formally opened on Tuesday of this week by Mr. Robert A. Burrows, vice-chairman of Manchester Collieries, Ltd., and a former president of the Association. The director of research and the technical staff, with the exception of those engaged on palæo-botanical work, which will continue to be carried out at Bolton, will be accommodated in the well-equipped offices and laboratories at Cheetham, the building being a modern fireproof structure of three storeys.

The Technology of Building.

An interesting development at Manchester University is the institution of a degree course in building technology, starting in October. The course will cover a period of three years, leading to the degree of Bachelor of Technical Science, and will provide training in building science and construction, provision being made also for a scientific study of building materials. Summer work in the offices and workshops of building trade employers in the Manchester area will constitute an important part of the practical training of the students, who will also study French or German in order to become acquainted with the technique abroad.

Merger of Textile Machinists.

Formal registration of the merger of Lancashire textile machinists under the title of Textile Machinery Makers, Ltd., with a nominal capital of £100, is now announced. This represents the culmination of efforts made over a number of years to effect a rationalisation of the industry. Six well-known Lancashire concerns are involved in the merger—Asa Lees and Co., Ltd., Oldham; Brooks and Doxey (1920), Ltd., Manchester; Dobson and Barlow, Ltd., Bolton; Howard and Bullough, Ltd., Accrington; John Hetherington and Sons, Ltd., Manchester, and Platt Brothers and Co., Ltd., Oldham, and their combined capital is more than £8,500,000.

Industrial Results.

The directors of John Hetherington and Sons, Ltd., Manchester, one of the firms included in the textile machinery merger, announce this week that, owing to continued bad trade, they are unable to pay the half year's dividend on the 7 per cent. preference shares due on September 30th. The last distribution was one of 3½ per cent. in September, 1929. The company sustained a net loss of £73,867 in the financial year ending March 31st last, this following on a loss of £53,344 in the previous year, and a net profit of £70,578 in 1928–29. The directors of William and Williams, Ltd., Chester, manufacturers of metal windows, report a trading profit for the twelve months to the end of April last of £8969, compared with one of £21,833 in 1929–30. The preference shareholders are to receive the usual dividend of 8 per cent., but no dividend is proposed on the ordinary shares, against 5 per cent. and 12 per cent. in 1929–30 and 1928–29 respectively.

Non-ferrous Metals.

The Government announcement at the beginning of the week of the departure from the gold standard had the immediate and general effect of stiffening quotations on the non-ferrous metals markets, and although there has been some reaction since prices in all cases are appreciably higher than they were a week ago, when the markets were in the throes of widespread weakness. At this early stage it is both difficult and dangerous to draw conclusions, but it is more than likely that the recent record low prices have been definitely left behind and that what the producers of the metals strove hard, but failed to achieve, has been brought about by extraneous forces. If steadiness continues, even without any further marked upward movement, a stimulating factor to the metal-using industries may have been provided. Meanwhile, tin is higher on balance to the extent of about £4 a ton, copper £1 5s., lead £2 5s., and spelter a little over £1. Although, of course, much of the movement in the metals during the past few days has been of a speculative character, there has also been more genuine buying for industrial use. The market hope is that it may continue.

Iron and Steel.

A growing cheerfulness in the iron and steel markets here succeeded rapidly to the anxious feeling of the past few weeks, and to the initial shock of the gold standard bombshell at the beginning of this week. One beneficial effect should be to remove the uncertainty always incidental to a market from which confidence in price stability is lacking, and thus help to bring about a renewal of forward buying. The general opinion this week has been that prospects of further price concessions by iron and steel makers are very remote, an opinion that has been shared by a good many consumers. In the case of foundry iron, for example, actual sales have been heavier, users evidently regarding it as a wise policy to add to stocks or to the tonnages against which they have to draw. Up to the present this improvement has not extended either to manufactured iron or to steel, although, in the case of the latter, rollers are inclined to look for some early improvement. No change in the price position has occurred since last week. With regard to imported materials, however, continental works represented on this market have withdrawn quotations for the time being, and are said to be refusing to accept orders. Appreciably higher prices for imported iron and steel products are looked for when foreign interests have had time to adjust themselves to the new conditions.

BARROW-IN-FURNESS.

Hematite.

The general condition of the pig iron market remains dull, but, in view of changed conditions, it will be interesting to note how it will be affected in the next few months. There may be an improvement in the home demand, but one has to set against this the purchasing powers of the Continent and America. For some time American business has been very quiet, but there have been regular shipments, if small, comparatively, to the Continent. Owing to restricted output stocks have been reduced, and with more activity at Workington, the local consumption on steel account will increase. There are rumours of another furnace being started, but at the time of writing no definite decision has been arrived at. The iron ore trade, both native and foreign, is very quiet, and, apart from a poor local demand, outside business is only slight. The steel trade continues dull. Only hoops and small sections are being turned out at Barrow.

SHEFFIELD.

(From our own Correspondent.)

The General Position.

THERE is hope that the iron and steel trades will share in that improvement of export business which is expected to follow from our suspension of the gold standard, and if that should come about it will be very welcome, for the export side of Sheffield's trade has been growing weaker and weaker for a considerable time. At the monent, of course, it is too early to look for any signs of recovery from this cause, and the position as a whole shows further weakness rather than progress. This is attributed to the Budget proposals, which led to a feeling of uncertainty with regard to the future. Consumers of steel and steel products have been displaying the greatest caution in placing their orders, and covering only their immediate requirements. As previously stated, one or two firms whose own manufactures provide an outlet for their open-hearth steel, have been able to increase their output of that material to some extent. There is, however, no such increase to report in the production of steel for general commercial purposes, which still remains at a very low level. Other branches of the steel trade are also in much the same condition as has been recently reported.

Heavy and Light Manufactures.

The shipbuilding industry is still taking only very light quantities of Sheffield products. A reminder that a Sheffield firm is engaged on the construction of the world's largest liner is afforded by the report that huge castings for the new 73,000-ton Cunarder are to be removed this week-end from the works of Darlington Forge Limited, to the shipyard of John Brown and Co., Ltd., at Clydebank. There are eight castings altogether, comprising the heaviest parts of the stern frame and outer shaft brackets. They have a total weight of 625 tons, have to be loaded on special trucks, and are of such enormous and overhanging dimensions that an entire railway track is to be commandeered for their removal to Middlesbrough, whence they will be sent by water. A few orders for railway material have been reported during the past week. Both the United Steel Companies and J. Baker and Bessemer, Ltd., are to make tires for the Crown Agents for the Colonies, while Brown Bayley's Steel Works, Ltd., are to supply axles to the Egyptian State Railways at a total price of £5387. The railway steel departments generally, however, remain very quiet, and could do with a great deal more work, alike in axles, tires and springs. One of the healthiest branches of local trade is still that producing stainless, heat-resisting and corrosion-resisting steel, the demand for which is well maintained. A good volume of products is still turned out to meet the requirements of the automobile trade, but it is far below the normal level.

Some Company Reports.

I referred last week to the unsatisfactory trading results of the Sheffield Forge and Rolling Mills Company, Ltd., last year. The report of this company, one of the largest of its character in the city, bears out what has been said on more than one occasion about the depression at the local rolling mills. It is stated that the works did not run, during the twelve months ended June last, at more than 20 per cent. of their capacity, and attention is also called to the "wretched oddment nature" of the business, which rendered any idea of profit out of the question. Another disappointing report comes from Ibbotson Bros. and Co., hitherto one of the most successful of local steel firms. They have made a loss of £6879 and do not recommend an ordinary dividend. Hardypick, Ltd., is in a similar position, its loss being £4609. The report of the Sheepbridge Coal and Iron Company is better. Although the net profit is down, it is still £74,344—against £93,722—and the ordinary dividend is maintained at 5 per cent.

Special Steels.

The trade in high-speed steel and other special steels continues quiet. While the home market is taking moderate quantities of these products, and also of engineers' tools, exports have been dwindling for some time. The latest returns show that exports of special steels in August were of the value of £17,208, as compared with £23,401 in July, and that the total trading for the first eight months of this year was of less than half the value of that of the corresponding period of last year. On the other hand, imports of special steels rose from £14,645 in July to £19,216 in August. The trade for the eight months amounted to £114,312, as against £154,656 last year and £198,084 in 1929.

Orders Placed.

The list of Government contracts for August shows that, as usual, Sheffield firms are to contribute to the requirements of several State departments. In addition to the tires already mentioned, the Crown Agents for the Colonies are buying tanks, and these are to be obtained from Newton, Chambers and Co., Ltd. The Admiralty has placed contracts for high-speed drills with Samuel Osborn and Co., Ltd., and also with Thos. Firth and John Brown, Ltd., as well as an order for cooking equipment with Moorwoods, Ltd. The War Office is purchasing bullet-proof plates from Vickers-Armstrongs, Ltd., while the Air Ministry has ordered bombs from Hadfields, Ltd., and hack saw blades from the Sheffield and Hallamshire Hack Saw Company, Ltd. Another interesting order reported during the week is one booked by the Laycock Engineering Company for one of its latest model six-gun high-pressure washing plants, for despatch to New Zealand.

Sand-spun Pipes.

The magnificent new plant, for the manufacture of iron pipes by the sand-spun process, which has been installed by the Staveley Coal and Iron Company, Ltd., was formally opened last week, although, as a matter of fact, it has been in actual operation for the past three months. Particulars of the plant are given elsewhere in this issue. At present only one shift is being worked—in the mornings—but developments are hoped for. Sir William Bird, the chairman of the company, made the interesting statement that, since the plant was brought into operation in June, 51 miles of sand-spun pipes have been manufactured and sold. I understand that the company has on hand some good orders for pipes of various classes, including large junction pipes, breeches, &c. Some of these pipes are about 5ft. in diameter, and are to form two, three or more junctions in very large water mains. One set is being made to the order of a London power company. There are many inquiries about for pipes for local authorities and others, so that this Derbyshire industry has good prospects.

Cutlery and Plate.

There is not much movement to report in the cutlery and plate industries. Many of the firms are just carrying on, and making little, or no, profit, though a few are better placed, and have good order books. It is thought that higher taxation may cause people to economise in silver and cutlery, which come within the category of luxury or semi-luxury goods. On the other hand, the suspension of the gold standard, and the fall in the value of the £ abroad, should have a useful effect in helping the export trade and reducing the flow of imports. Some movement in this direction is recorded by the August returns; at any rate, the export trade has steadied, and shows no further reduction, while imports have fallen off. Under the latter head, the total for August was £34,957, or £6000 less than in July. The export figures show declines in knives and scissors, but these are almost balanced by increases in safety razors and blades. The position of Sheffield scissors in the export markets is disappointing, especially as the trade showed an upward tendency last year. Sales of ordinary razors are still falling. The total value of cutlery exported during the eight months of this year amounts to £402,000, as compared with £605,815 last year, and £748,149 in 1929. The difference is to some extent accounted for by lower prices.

NORTH OF ENGLAND.

(From our own Correspondent.)

Increased Export Trade Expected.

THE financial situation has, of course, been the chief topic of conversation in North of England commercial circles this week, and it is encouraging to note the steadiness that has been maintained in the commodity markets. There has been no excitement, and the general feeling prevails that the credit of the country is sound. It is

too soon to tell what the effect will be on trade. The first impressions are that exports will probably increase, but a movement in this direction is not likely to take shape until the home and foreign exchanges become settled.

Cleveland Iron Trade.

There is little or no change in the position of the Cleveland pig iron trade. Output is at a very low ebb. A large proportion is absorbed at producers' own works, and the surplus available for the market is well taken up by home consumers who have to buy. Transactions are almost confined to direct sales by makers to users, second-hands still being precluded from supplying principal home consumers. Efforts to sell at lower prices to firms in Scotland meet with little success in face of the keen competition of dealers in overseas products. Supplies of Midland iron are still coming forward for consumption on Teesside. Prices are steady, No. 1 Cleveland foundry iron being 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

The embarrassing statistical state of the East Coast hematite pig iron trade keeps values at a low and unremunerative level, despite the now very small output. Only four hematite furnaces—two of which are on slack blast—are at present in operation on the North-East Coast. Producers are anxious to reduce their heavy stocks, and readily sell parcels at well below cost. Ordinary qualities are no more than 59s. 6d. and No. 1 is offered at 60s.

Iron-making Materials.

There is no business passing in the foreign ore trade. Consumers are heavily bought and have large stocks. In view of the disturbed condition of the exchanges, sellers have ceased to quote. Blast-furnace coke is abundant, and for good medium kinds delivered at the works 15s. is still generally asked.

Manufactured Iron and Steel.

The steel makers have reaffirmed the agreed home prices for finished material, but there has been very little fresh business. The only department showing any activity is that dealing with constructional steel.

The Coal Trade.

There is not much fresh business moving in the Northern coal trade. Operators are holding off until the effects of the Government financial decision on the market can be properly estimated. Meantime the position is fairly satisfactory, in view of all the disturbing influences. Shipments have been heavier than for some weeks past, a fair number of steamers having left with cargoes for the Black Sea and the River Plate. To the end of the current quarter Northumberland large coals will not be easy to secure, as bookings are so good. Collieries whose quotas have become exhausted have purchased the unexhausted allowances of other pits, and so the whole of the county's quota to September 30th of 73·5 per cent. of the standard tonnage is likely to be fully absorbed. The best grades of Northumberland steam coals command up to 14s., and seconds 12s. to 12s. 3d. Other prices are firm, owing to the scarcity of supplies for the remainder of the quarter. Apart from what may happen in respect of the general financial situation, October has the appearance of opening favourably, as there is a desire to cover for that month. Durham steams have not been in such good demand as Northumberlands and their position is unaltered, with best qualities quoted at 15s. Stocks of steam smalls are undiminished in both counties. Durham gas coals are by no means as active as they usually are in late September, and prices are at a minimum. Chief brands of bunker coals are rather scarce for early delivery. Coking coals are without new feature, and in the coke section there is a steady demand for gas makes. Current output of the latter is fully absorbed. There is no lack of supplies of ordinary patent foundry coke, but forward inquiries appear to be rather better. All coke prices are unchanged.

French Coal Importations.

The North-East Coast Coal Exporters' Association has received particulars of the probable effects of the new licensing system respecting coal imported into France. The allocations to hand indicate that the effects in Northumberland and Durham may not be so severe as had been anticipated, but the fact remains that there is to be a lessened importation, and it will mean decreased business for the various ports that regularly supply coal to France. The restricted quantities may not seem to be very large at first glance, but the principle of controlling imports is not confined to France in the matter of coal, therefore the cumulative effect is all to the detriment of exporting areas like Northumberland and Durham. It is expected that the monthly allocations to the United Kingdom will work out as follows:—Coal, 660,000 tons; briqueting coal, 83,000 tons; and coking smalls, 76,000 tons; a total of 819,000 tons. This is an improvement on the original total, which was estimated at 787,000 tons. No licence is required for coking smalls, and no limit is placed on quantity.

SCOTLAND.

(From our own Correspondent.)

Improvements at Grangemouth Docks.

THE London, Midland and Scottish Railway Company is installing up-to-date coal transporters at Grangemouth docks, to take the place of the old coal hoists. The new transporters can ship 600 tons of coal per hour. In addition, a new oil jetty is to be constructed in the eastern channel, with the dual object of providing more accommodation for general traffic in Grange Dock, and separating the ships dealing with general cargo from those carrying oil, thus ensuring safety to general cargo should fire break out on the oil jetty.

Shipbuilding Contract.

It is announced that McKie and Baxter, Ltd., of Paisley, have received an order to build to their design a paddle steamer for river service abroad. The hull and machinery are to be erected here, then dismantled, and re-erected abroad. A feature of interest is the fact that this is the first important contract secured by the newly formed marine engineering firm, which is a combine of McKie and Baxter, Ltd., Govan, and Campbell and Calderwood, Ltd., Paisley.

Steel.

So far there is no improvement in the steel trade, and nothing new has been mentioned in the consuming industries to give any encouragement for the immediate future. Shipbuilding requirements are extremely modest. Ship and boiler plates and sections are poorly specified, and export business is unreliable. Consequently producers experience great difficulty in maintaining even a minimum output. Structural material has fallen off in demand. Though tube makers are still short of specifications, the inquiry has improved and producers are more hopeful. Steel sheets are poorly bought, both in respect to the black and galvanised branches. Price levels as a rule are maintained, but individual quotations are keen.

Iron.

Bar iron and re-rolled steel bars continue to experience poor conditions. Usual seasonal demands are absent or nearly so, and competition remains keen. The former suffers from the lower price of steel, and the latter from keen foreign competition. Bar iron is unchanged for home consumption, but something under the current quotation of £9 10s. could be done for export. Similarly, the price of £6 per ton home and export quoted for re-rolled steel bars might be shaded for a good specification.

Pig Iron.

The reduction in the price of Scottish pig iron has not produced any beneficial effect so far. The production is still confined to the output from one furnace, but stocks are quite equal to current demands. Quantities of material continue to arrive in this district, last week's imports amounting to over 2100 tons. Total shipments amounted to 148 tons, of which 92 tons went abroad.

Coal.

Apart from seasonal developments in the home demand, there is no change in the Scottish coal trade. Shipping demands continue scarce, and the collieries in Fifeshire and the Lothians in particular have a poor outlet. Lothians steams have a poor market, and though third-class Fifeshire steams are better placed than first-class qualities, that is a result of curtailed outputs. In all districts the firmness of treble and double nuts constitutes the feature of the market. Prices on the whole show little change. Aggregate shipments amounted to 200,581 tons, compared with 248,793 tons in the preceding week, and 243,031 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal, Iron and Steel.

THE events of last week-end, involving the abandonment of the gold standard, were, at first, received with commendable restraint in all trading circles. The general feeling was at first that time was necessary to digest the real significance of such an important decision, but, as the days have passed, there has been a growing realisation that without being unmindful of the difficulties which have yet to be faced there are distinctly better prospects for the coal, iron and steel trades, inasmuch as the standardisation of the £ on a lower basis means a reduction of prices to foreign buyers. The road to prosperity is a very long one, but, at the same time, it is refreshing to see the change of attitude and the partial dispersal of the cloud of depression which has overhung this district for such a long period. So far as the coal export trade is concerned, there is a reasonable expectation of a better inquiry for suppliers from this country, as the depreciation in the value of the pound may make a difference of approximately 2s. 6d. per ton to the foreign purchaser, and such a reduction in the cost should certainly place this country in a much stronger position to compete with continental producers. Civic and commercial leaders are displaying a more lively interest in the possibility of new works being established in this area. There is a revival of efforts to persuade the Government to reconsider the question of coal being substituted for oil for naval vessels, and there will unquestionably be a greater demand for the abolition of the sytem by which the production of coal and its price is regulated, especially if there is a definitely better inquiry for supplies. Hopes are, of course, entertained that the home demand for coals will display material expansion, as factories and works get going, which would mean an additional call for coal. In the case of the shipping industry, the outlook is more nebulous, while, as regards the tin-plate industry, the position at the Swansea Metal Exchange on Tuesday was that, owing to the unsettled conditions prevailing, Welsh tin-plate makers refrained for the time being from offering plates.

The Coal Export Trade.

Returns of coal and coke shipments for last week were disappointing, as the total according to the G.W.R. Company's figures was only 426,695 tons, which compares with 437,950 tons for the previous week and with 526,194 tons for the corresponding period of last year. It will be seen, even from these statistics, that there is much room for improvement. Although the outlook is much more cheerful now, it must be recognised that there cannot be an immediate expansion in operations. People at home and abroad have to get used to the new conditions which have been brought about, and it was not at all surprising to find in the early part of this week that there appeared to be a disposition on all hands to mark time and watch developments. Shipments this week may, possibly, be a shade better than they were last week, when the number of idle tipping appliances reached the total of thirty-five. Arrivals of steamers over the week-end reduced this figure on Monday to thirteen, and there were four vessels waiting to berth at Swansea, but much more chartering of tonnage must take place than has been the case of late if collieries are to become really busy. The scarcity of prompt orders has been made clear by the state of the outward freight market, which, instead of moving in a direction of advantage to shipowners, has gone against them, especially for the Mediterranean, as tonnage has been fixed at 5s. for Genoa and 5s. 9d. for Alexandria, rates which have not prevailed for practically a quarter of a century. Coal contract operations are still quiet, but, from now on, there should be more interest displayed. The Danish State Railways have purchased a portion of their requirements from South Wales, and the Egyptian State Railways are calling for tenders for 140,000 metric tons of locomotive coals for delivery over the early part of next year at Alexandria, but prices have not to be in before December 8th.

South Wales Trade.

Recently issued statistics by the Great Western Railway Company relating to the trade at the docks in this area under its control, were by no means satisfactory. For the period of four weeks ended August 30th, imports totalled 330,014 tons, and exports 1,716,498 tons, making a total of 2,046,312 tons, which was nearly 44,000 tons less than for the previous month. The returns of trade for the eight months ended August 30th must cause considerable anxiety, as imports and exports aggregated 18,768,556 tons, which compares with 23,989,530 tons for the corresponding period of last year, a reduction of no less than 5,566,903 tons, or approximately 25 per cent.

Miscellaneous Items.

At a meeting of the executive council of the South Wales Miners' Federation on Monday, it was announced that arrangements had been made for a resumption of work at the Risca Collieries. These collieries, which employ about 800 men, have been idle for about six months in consequence of a dispute. The questions at issue are to be referred to arbitration. The Old Castle Tinplate Company, Llanelly, restarted four additional mills on Tuesday, thus bringing the number in operation to ten. For a time, at any rate, fewer tankers will be bringing oil to Swansea to be refined at the National Oil Refineries, Skewen. The number will be reduced to three or four per month. The number of sailings of vessels with the finished product will be greater. There is no truth in the report that the refineries are closing down. The position is that stocks are high, with the result that supplies of crude oil coming in are being reduced. Whilst work has been resumed at the Caerau Colliery, after an idle period of several months, 300 miners employed at the House Coal Colliery, Pengam, have received fourteen days' notices to terminate contracts. At the end of last week notices were posted up at the Llanelly Steelworks that, owing to the importation of foreign bars and because there was no demand whatsoever for the company's own product, the whole of the plant would come to a complete standstill after Saturday morning's shift. The notice affected about 700 men, but the closing down of the works, naturally, reacts on other industrial establishments in the town of Llanelly and district. The Pemberton Tinplate Works, Llanelly, also closed down on Saturday. These works, which are associated with the Welsh Tinplate and Metal Stamping Company, comprise four mills and employ about 250 workmen.

Current Business.

Operations for steam coals for prompt shipment are very quiet, and prices generally are on the minima. The executive committee of the South Wales Coal Marketing Association decided recently not to reduce the minimum prices for small coals. Patent fuel and coke are moving off slowly. As regards pitwood, the market is somewhat disorganised at the moment by the depreciation of the pound. French sellers are seeking higher prices to meet the lower value of sterling. In one case it is reported that a French exporter of pitwood has declined to load a vessel with supplies in France unless the importer agrees to pay in francs, though the contract stipulates for payment in sterling.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

EDWARD G. HERBERT, Ltd., inform us that Mr. Alan Kiernan, A.M.I. Mech. E., has been appointed as their representative in Lancashire, Cheshire, and North Derbyshire.

JOHN BENNIE, Ltd., Star Lift Works, Glasgow, has found it necessary, owing to the expansion of its business, to extend their London premises and are removing from 47, Victoria-street, S.W. 1, to 39, Victoria-street, Westminster, S.W. 1; telephone, Victoria 7115 (three lines). The firm has also, on account of the expansion of its provincial business, been compelled to open up new premises at Manchester, Leeds, Dublin, Liverpool, Newcastle-on-Tyne, and Edinburgh.

CONTRACTS.

DUFFIELD COAL PRODUCTS, Ltd., of Imperial House, Kingsway, London, W.C. 2, has received an order from South Africa for Gyro pulverised fuel equipment for three Babcock and Wilcox boilers, each of 17,000 lb. per hour normal rating.

BERNARD HOLLAND AND CO., 17, Victoria-street, S.W.1, have received a repeat order from Apex Trinidad Oil Co., Ltd., for a Type DN 23—130 H.P. natural gas engine direct coupled to two of their Type K. 180 gas compressors, for use in Trinidad.

BLACKSTONE AND CO., Ltd., Stamford, have received a contract, valued at about £14,000, for the supply and erection of the whole of the machinery required for the Eastleigh and Bishopstoke sewerage scheme, contract No. 2. The machinery includes the complete power-house plant for the supply of electricity for driving the sewage pumps and lighting. The pumping station equipment to deal with the crude sewage and storm water will be automatic in operation. It will include thirteen vertical Blackstone "Unchokeable" pumps varying in size from 4in. to 14in.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/– to 20/6
(1) Spanish	14/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	14/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 8 6	—
No. 1 Foundry	3 12 0	—
No. 3 Foundry	3 9 6	—
N.E. COAST—		
Hematite Mixed Nos.	2 19 6	2 19 6
No. 1	3 0 0	3 0 0
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	–	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*); 4 0 6 (*b*); 4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 10 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 10 0	—
Best Bars	11 0 0	—
Double Best Bars	11 10 0	—
Treble Best Bars	12 0 0	—
LANCS.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 5 0 to 10 7 6	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 7 6 to 9 0 0	—
Gas Tube Strip	10 10 0 to 10 12 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 10 0	10 0 0
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 10 0	7 10 0
Sheets (Gal. Cor. 24 B.G.)	10 12 6	9 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 10 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 17 6	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	6 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars	6 7 6 to 7 0 0	—
Billets and Sheet Bars	4 17 6 to 5 10 0	—
Galv. Sheets, f.o.b. L'pool	8 15 0 to 9 0 0	—
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	13/6
Block Tin (cash)	117 17 6
„ (three months)	120 10 0
Copper (cash)	30 10 0
„ (three months)	31 5 0
Spanish Lead (cash)	12 15 0
„ „ (three months)	12 16 3
Spelter (cash)	12 5 0
„ (three months)	12 12 6
MANCHESTER—	
Copper, Best Selected Ingots	38 0 0
„ Electrolytic	39 0 0
„ Strong Sheets	62 0 0
„ Tubes (Basis Price), lb.	0 0 10½
Brass Tubes (Basis Price), lb.	0 0 9½
„ Condenser, lb.	0 0 11½
Lead, English	14 17 6
„ Foreign	13 10 0
Spelter	13 2 6
Aluminium (per ton—raw ingot)	£85

FERRO ALLOYS.

Tungsten Metal Powder	1/11½ per lb.	
Ferro Tungsten	1/8½ per lb.	
	Per Ton.	Per Unit.
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 0 0	7/–
„ „ 6 p.c. to 8 p.c.	£20 10 6	7/–
„ „ 8 p.c. to 10 p.c.	£19 12 6	6/6
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£29 10 0	10/–
„ „ „ 1 p.c. carbon	£33 10 0	12/–
„ „ „ 0·70 p.c. carbon	£35 15 0	13/–
„ „ „ carbon free	9½d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£10 7 6 scale 5/– per unit	
„ „ 75 p.c.	£15 0 0 scale 7/– per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£197	
Ferro Cobalt	8/– per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/6
„ „ Ell	14/3
„ „ Splint	14/– to 15/9
„ „ Trebles	13/– to 13/6
„ „ Doubles	12/6
„ „ Singles	10/–
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/6
„ „ Jewel	17/–
„ „ Trebles	13/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	11/– to 12/–
Screened Navigation	17/–
Trebles	14/6
Doubles	13/–
Singles	10/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	10/9 to 11/–
Secondary Steam	10/– to 10/6
Trebles	13/6
Doubles	13/– to 13/3
Singles	10/–

(8) N.W. COAST— ENGLAND.

	Inland.
Steams	20/–
Household	30/– to 51/–
Coke	20/– to 20/6
NORTHUMBERLAND—	
Best Steams	13/6
Second Steams	12/–
Steam Smalls	7/6 to 8/–
Unscreened	12/6 to 13/–
Household	27/– to 39/–
DURHAM—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/– to 37/–
Foundry Coke	24/–
SHEFFIELD—	Inland.
Best Hand-picked Branch	24/6 to 25/6 —
South Yorkshire Best	23/6 to 24/6 —
Derbyshire Best Bright House	21/– to 22/– —
Best House Coal	21/6 to 22/6 —
Screened House Coal	19/– to 20/– —
Best Screened Nuts	18/– to 19/– —
Small Screened Nuts	16/6 to 17/6 —
Yorkshire Hards	17/– to 18/6 —
Derbyshire Hards	17/– to 18/6 —
Rough Slacks	9/6 to 10/6 —
Nutty Slacks	7/6 to 8/6 —
Smalls	5/6 to 6/6 —
Blast-furnace Coke (Inland)	10/– on rail at ovens
Furnace and Foundry Coke (Export), f.o.b., 14/– to 15/–	

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	19/6
Second Smokeless Large	18/9 to 19/6
Best Dry Large	18/6 to 18/9
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/–
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/– to 13/6
Ordinary Smalls	11/– to 13/–
Washed Nuts	18/– to 21/–
No. 3 Rhondda Large	19/9 to 20/–
„ „ Smalls	15/– to 16/–
No. 2 „ Large	17/– to 17/3
„ „ Through	15/6 to 16/–
„ „ Smalls	14/– to 14/3
Foundry Coke (Export)	22/– to 36/6
Furnace Coke (Export)	16/6 to 17/6
Patent Fuel	19/– to 19/9
Pitwood (ex ship)	24/6 to 25/–
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	35/– to 37/6
Seconds	27/– to 31/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 45/–
Nuts	40/– to 46/–
Beans	24/9 to 28/3
Peas	21/– to 22/–
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/6 to 9/–
Steam Coals:	
Large	20/– to 20/6
Seconds	18/– to 20/–
Smalls	11/6 to 13/–
Cargo Through	16/– to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/– if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

Colonial Machinery.

THE meetings of the congress on national fuels were continued at the Colonial Exhibition last week. One was devoted to fuels for public works plant and machinery in the colonies. The chairman, Monsieur Maitre Devallon, General Inspector of Public Works in the Colonies, said that the use of machinery was less profitable than native labour so long as there was an abundance of it, but that labour was now being drawn more and more into the agricultural industry, and the lessening supply and higher wages made the employment of machinery more economical and tended to give an increasing advantage to machinery. The point had now been reached at which machinery was necessary in West Africa to make up for the labour deficiency. Generally, machines sent to the colonies remained a long time without being used because manufacturers did not provide facilities for erection in a country in which labour was unskilled. That was one reason why American firms were successful in supplying public works machinery in West Africa. They had a resident engineer there, who saw that the machinery was erected and used to the best advantage. Machines should also be sent out with an ample supply of spare parts, without which they ran the risk of remaining idle for some weeks for the sake of a bolt or other small part that had to be obtained specially from home. The manufacturer, he concluded, should supply with each machine full instructions that would enable unskilled men to erect it and work it satisfactorily, or, what was still better, a number of makers should have a resident engineer in West Africa to look after their interests. Members of the congress complained that French manufacturers were not securing a fair share of the trade in machinery with the colonies, and affirmed that the colonies should be assimilated with the mother country so far as import duties were concerned. Naturally, the Government gives preference to French machinery wherever possible, and if home makers do not obtain a larger share of the trade it is because they have not the same facilities as their rivals for economically manufacturing public works and colonial machinery. It is probable that one outcome of the congress will be the offer of special rail and shipping freights for goods to the colonies, as well as other advantages.

The Trans-Saharan Railway.

At the meeting of the congress devoted to oils for traction, Monsieur Maitre Devallon, of the Public Works Department, gave an address on the Trans-Saharan Railway scheme, with which he is closely identified. He affirmed that all the difficulties in the way of that enterprise had been overcome by the introduction of the oil-electric locomotive. There were now, he said, no difficulties whatever in the way of constructing the Trans-Saharan Railway. When built, it would be possible to carry goods from the Niger to the Mediterranean ports at a cost of 150f. a ton. With the development of the rail motor coach the cost of running a 3-ton car would be 7·9f. per kilometre, and the use of pneumatic tires would permit of rail coaches running day and night at high speeds and traversing the Sahara more quickly than commercial aircraft, which only travelled by day. The railway would work with the aeroplane and motor car because, he said, the railway would make more by carrying luggage for those travelling by air than it would by carrying the passengers themselves, and the motor car would connect up the railway with the oases along the route. Another communication described a new oil motor rail coach which has been running experimentally on the Midi Railway. It is built with a duralumin frame 12 m. long and 2·8 m. wide. Fitted with a Junkers oil engine of 75 horse-power, the coach has a total weight of 6800 kilos. and carries a load of 5500 kilos. It travels at a maximum speed of 50 miles an hour, with a consumption of 15·5 litres of gas oil for 62 miles. It was suggested that motor coaches running on vegetable oils would ultimately be employed on the colonial railways if such oils could be produced locally at a sufficiently low cost.

Paris Water Supply.

The long controversy between the Paris municipality and the local populations over the scheme for supplying Paris with water from the Vals de Loire has been brought to an end by the Government declaring it to be a work of public utility. This means that the municipality is empowered to acquire any rights and property that may be necessary to carry out the undertaking. In order to meet local objections that the pumping of a million cubic metres of water a day might ultimately exhaust the supplies under the sands of the Vals de Loire, and lower the level of the Loire itself, the town of Paris is required to construct reservoirs having a capacity of not less than 220 million cubic metres, which will store water during the flood season and return it to the river in times of drought. So long as the level of the river Loire is maintained there can be no danger of diminishing the underground supply. The water will be delivered from the Vals de Loire to Paris by gravity, and the quantity will be sufficient, with that already available, for the probable needs of the Department of the Seine for an indefinite period.

Tidal Energy.

The scheme for the construction of a tidal power station which was started some years ago at Aber W'rach, to the south of Brest, is likely to remain in abeyance for an indefinite time in view of the refusal of the company to continue the work unless the State pays its promised contribution to the cost of the enterprise. On account of the financial situation it is doubtful whether the State will be able to provide funds for a purely experimental work. The company is an international concern in which American and Swiss interests are largely represented. It is now reported that the scheme which has been developed for a tidal power station in the Bay of Rotheneuf, in Brittany, will be put in hand shortly. This scheme was proposed several years ago as a rival to that of Aber W'rach. The bay will be divided to form two reservoirs, arranged to ensure that the turbines will develop continuously between 1050 and 6700 horse-power.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM ENGINES.

355,142. November 24th, 1930.—THE LUBRICATION OF HIGH-TEMPERATURE STEAM ENGINES, O. Simmen Erlach, Canton Berne, Switzerland.

It is suggested that when reciprocating engines work with highly superheated steam, much oil is lost through being thrown off the rubbing surfaces and being spoiled by contact with the

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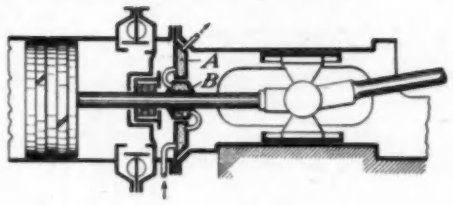


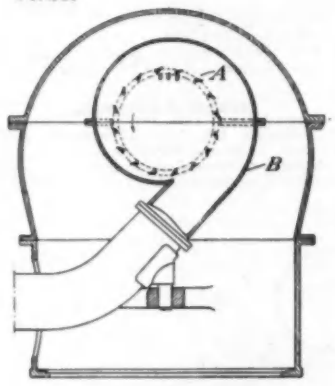
hot parts of the engine. As a consequence the inventor arranges a baffle A, just in front of the stuffing-box, which is water cooled, and a muff B round the piston-rod, which is also water cooled. Any oil thrown off from the piston-rod or the crosshead is cooled immediately on striking this baffle and drops down into a sump below in a condition to be used again.—*August 20th*, 1931.

TURBINE MACHINERY.

355,126. November 5th, 1930.—STEAM TURBINES, Aktiebolaget Ljungstroms Angturbin, Vastra Tradgardsgatan 17, Stockholm, Sweden.

This invention is concerned with radial flow turbines which work against a back pressure and aims at the conservation of

Nº 355,126



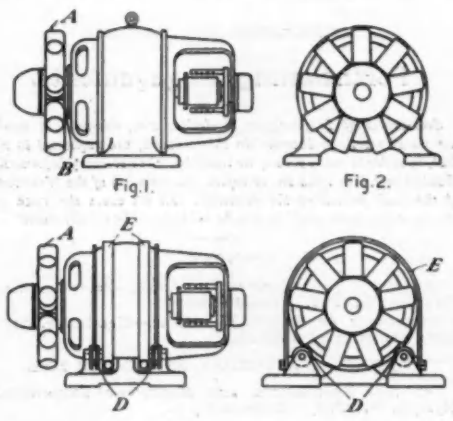
the kinetic energy of the steam as it leaves the last row of blading. To this end the exhaust is directed by a series of guide blades A into a volute B, which is separate from the main turbine casing in such a manner that it follows the contour of the volute. A mathematical example is mentioned in the specification.—*August 20th*, 1931.

DYNAMOS AND MOTORS.

355,009. August 7th, 1930.—A COMBINED PRIME MOVER AND AN ELECTRIC GENERATOR, Siemens und Halske Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

An electric generating unit constructed in accordance with

Nº 355,009

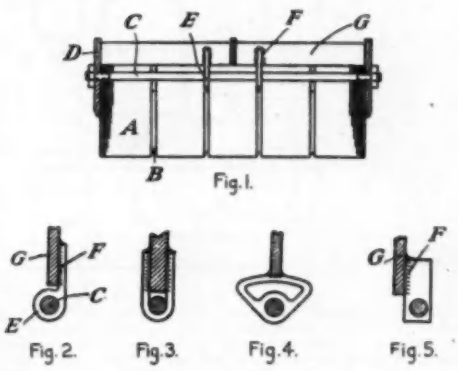


this invention consists of a nine-cylinder engine A. The connection of the engine with the generator is effected by means of a flange B on the generator casing. In Figs. 3 and 4 the generator A is supported on rollers D, and together with the engine can be made to be rotatable around its axis. During operation the generator is securely held by means of iron bands E, which must be released before a rotaton of the generator over the rollers is possible. The object of making the machine rotatable is to facilitate repairs to the engine.—*August 20th*, 1931.

355,066. September 15th, 1930.—DYNAMO-ELECTRIC MACHINES, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

In dynamo-electric machines, more particularly in large welded machines, the fixing of the packets of stampings, which form the active iron of the machine, presents difficulties which have only been overcome by comparatively costly constructions, and the object of this invention is to eliminate these difficulties in a simple manner. In the drawing—Fig. 1—A denotes the packets between which are cooling slots B. The packets of stampings are clamped by bolts C between accurately machined pressure plates D. In some of the slots there are intermediate eyes E of about the thickness of the air slots, which embrace the bolts C and are connected at their ends by means of welding seams F to ribs G running in the direction of the axis of the

Nº 355,066



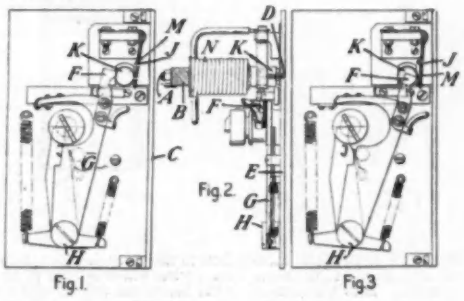
machine. The eyes—as shown in Figs. 2–4—may be of various shapes. For example, they may be made one-sided—as shown in Fig. 2—in which case they need be welded on at one place only, the eyes welded to one rib being arranged with advantage alternately on different sides of the rib. In certain cases, it may further be of advantage to use resilient eyes such as shown in Fig. 4 for fixing the bolts to the ribs. A particularly simple method of construction is provided if straps, cut out of a metal sheet, are used for fixing the bolts, a hole of the diameter of the bolt being bored in the straps—as shown in Fig. 5. The hole is bored with advantage unsymmetrically, thus providing in a simple manner the possibility of compensating for inaccuracies, when welding to the ribs G, by a reversed insertion of the straps. The specification also deals with the application of the invention to rotors.—*August 20th*, 1931.

SWITCHGEAR.

354,708. April 4th, 1930.—ELECTRIC SWITCHES, Frank Holden, and Measurement, Ltd., both of Townsend House, Greycoat-place, London, S.W. 1.

This invention relates to electric switches, and more particularly to such switches for operating in conjunction with prepayment electrical energy meters. The illustrations Figs. 1–3 show the invention applied to a switch for incorporation in a case with a D.C. electricity meter. A fixed electro-magnet core A, carried on a bracket B, is secured to the base C of the meter casing, the free end of this core coacting with a further pole piece D carried upon a plate E to which the prepayment mechanism—not shown—is attached. The pole piece D is thus put in magnetic communication with the base of the meter casing. Between the air gap so constituted, a thin insulated movable switch blade F is mounted upon an arm G carried upon a fixed pivot H, so as to be capable of an arc of swing which carries the blade from the position of Fig. 1 into the closed position in the air gap, as in Fig. 3, so as to come in contact with a resilient contact member J or which causes the blade to move outwards away from the air gap after breaking of the electrical connection. The ends of the pole pieces are shielded from elec-

Nº 354,708



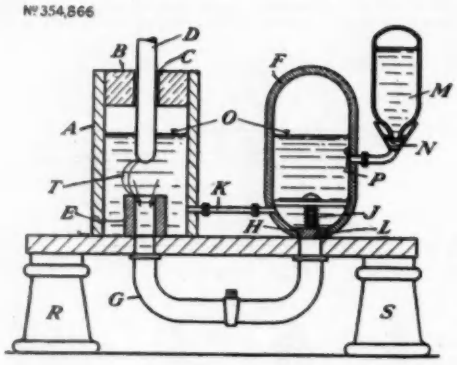
trical contact with the movable switch blade J by means of caps K of insulation material fitted to the pole pieces. These caps incidentally serve to limit the movement of the resilient contact member J, when the switch is in the open position. The resilient contact member comprises a flat blade of copper occupying a plane at right angles to the plane of the movable contact blade, and the elasticity of this resilient blade is preferably augmented by means of a steel blade spring M contacting with the rear surface of the resilient blade. The first-mentioned magnetic core piece is furnished with a winding N in series with the load circuit. In operation, when the switch is closed, the movable blade is moved so as partly to cut through the air gap and to come in contact with the resilient contact blade J, which moves slightly out of contact with the pole piece caps K. When the circuit is to be opened the movable blade F is tripped, and swings rapidly into its open position—Fig. 1—away from the air gap. In so doing it comes out of contact with the resilient contact member J and the arc, which necessarily forms, is blown out upwards by the magnetic flux traversing the air gap. It will be appreciated that the extinguishing effect of the magnetic field is proportionately greater with increase of the magnitude of the current to be broken.—*August 4th*, 1931.

354,866. May 21st, 1930.—ELECTRIC SWITCHES WITH ARC EXTINCTION BY SELF-GENERATED VAPOUR, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

The arc formed at the contacts of a switch constructed in

accordance with this invention is suppressed by vapour generated by the switch, which is constructed on the following lines:—A is the expansion chamber with its cover B, in which there is situated an inlet aperture C. D is the movable switch pin and E is hollow cylinder stationary switch member. F is an air vessel, G a connecting pipe which opens into the centre of the hollow cylinder switch member, E, H a valve with a valve spring J. K and L are small conduits, through which the liquid compensation or balance is effected. M is a bottle filled with liquid situated in the funnel N. The lower end of the bottle stands at a level equal to that of the liquid O. P is a non-return valve. R and S are insulators which carry the switch. On separating the switch members D and E, an arc T supervenes and evaporates part of the liquid. If the power of the circuit is only slight the pressure in the expansion chamber will only slightly increase and the valve H remains closed. If, on the contrary, the power is great, then the valve H opens and a part of the liquid in the

№ 354,866



expansion chamber A is forced through the pipe G into the air vessel F. In this way the space for the vapour in the chamber A is increased and the pressure does not exceed the permissible value. The liquid flows past the base or foot points of the arc and cools it. The egress of vapour and liquid through the narrow annular surface between the switch pin and the edge of the aperture in the cover is small, owing to the great resistance to flow in the conduit C, so that the pressure is sustained as long as switch pin D is in the lid B. After the passing out of the switch pin D from the narrow aperture C of the expansion chamber, a very sudden expansion of the vapour occurs and this causes the extinction of the arc. Owing to the over pressure of the air vessel F, the liquid is now pressed back through the narrow conduits K and L into the expansion chamber A. If, however, the loss of liquid is so great that the level of the liquid in the bottle F falls, then sufficient liquid will flow in from the bottle M until the normal liquid resistance of the liquid has been restored.—*August 20th*, 1931.

355,129. November 11th, 1930.—FUSIBLE CUT-OUT ELEMENTS, The English Electric Company, Ltd., of Queen's House, 28, Kingsway, London, W.C. 2, and Arthur Alexander Heath, of "Kantarra," Queen's-road, Kenilworth, Warwickshire.

The object of this invention is to confine the rise of temperature to a central portion of a fusible cut-out element, so that fusion and the rupture of the circuit takes place there, whereby damage to the fuse terminals or cartridge case, both by the transmission of heat thereto from the ends of the element and by the arc on blowing, is avoided. Heat concentration is obtained by branching the ends of the wire as shown. In Fig. 1 beads A of glass or other refractory heat-insulating material are used as the covering for the central portion of the element between the branches. In Fig. 2 a tube B is used.

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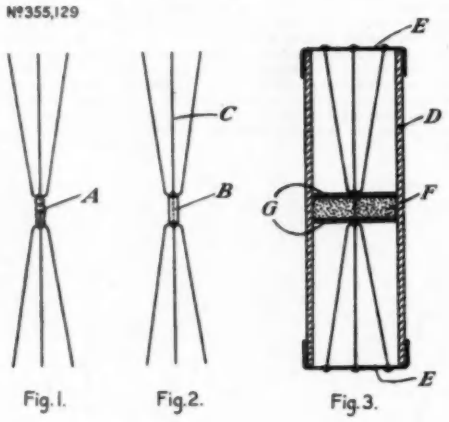

Fig. 1. Fig. 2. Fig. 3.

The beads or tube are threaded on to the through wire C before the attachment of the second cross wire, which is bent to form branches. It is preferable that the beads and tube fit the wire as closely as possible to reduce heat radiation. Fig. 3 shows a fuse wire situated in the usual manner inside a cartridge case D and secured by passing the ends through holes in the caps E and spot welded or soldered on the outside. Whereas it is usual in filled cartridge fuses to fill the whole of the case with some refractory powder or granules, in accordance with the invention the object is achieved by confining this powder—shown at F—between two washers G, threaded on the central portion of the wire. In the example shown, the branches locate the washers correctly, but in the case of a single fuse wire of the usual kind, the washers can be made a tight fit in the cartridge case.—*August 20th*, 1931.

AERONAUTICS.

355,115. October 29th, 1930.—BUOYANT FUSELAGES, The Blackburn Aeroplane and Motor Company, Ltd., Brough, East Yorkshire; F. A. Bumpus, Elloughton, Brough, and R. Tharratt, Westlea, Beverley-road, Hessle, East Yorkshire.

This invention aims at providing a body for an aeroplane which is buoyant, and yet provides accommodation for the controls within the main skin. The principal claim in the specification reads as follows:—A fuselage for aircraft comprising a water-tight monocoque body provided with internal partitions forming a certain proportion of said body into water-tight compartments, one or more of which compartments constitute tanks adapted to receive petrol, oil, or other fuel or liquid, and these compartments do not, in parts, extend to the normal profile of the fuselage, so that a space is left externally of said compartments, but internally of the profile for controls, pipes,

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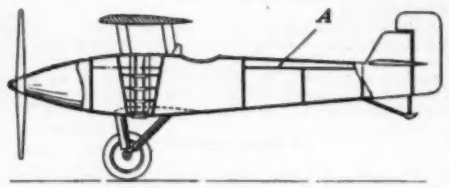

and other parts which have to pass from one part of the fuselage to another part of the fuselage. One of such spaces is indicated at A in the drawing.—*August 20th*, 1931.

GAS PRODUCERS.

354,962. July 14th, 1930.—PROCESS OF DISTILLING SHALE AND OTHER OLEIFEROUS MINERALS, H. Werner, 18, Ring, Gleiwitz, Upp.r Silesia, Germany.

The object of this invention is to obtain a process of distilling the oleiferous minerals, so that the oil vapours obtained will be substantially free from overheated particles and lend themselves to a satisfactory recovery of the by-products. With this object in view, the materials are introduced into the retort in a graded state of comminution, i.e., composed of grains of various sizes, so that the spaces between the coarser particles will be as nearly as possible completely filled up by finer ones, the charge being, moreover, compressed. The size and grading of the particles vary with the nature of the materials. Generally a suitably graded charge is composed of 10 per cent. 5 mm. grains, 18 per cent. 4 mm., 34 per cent. 3 mm., 25 per cent. 2 mm., and 13 per cent. grains of 1 mm. and less. With the materials in this condition, the penetration of the heat into the retort charge will be retarded, and the oil vapours will be able to escape without being overheated. The illustration shows how the charge is packed into the retort, with a central passage, and other radial passages, for the discharge of the gases.—*August 20th*, 1931.

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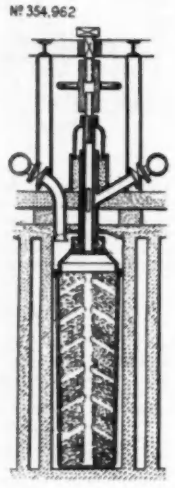

MISCELLANEOUS.

355,118. November 1st, 1930.—APPARATUS FOR MAKING DRY CELLS, *Britannia Batteries, Ltd., Britannia House, 233, Shaftesbury-avenue, London, W.C. 2.*

This machine is intended for the application of caps with

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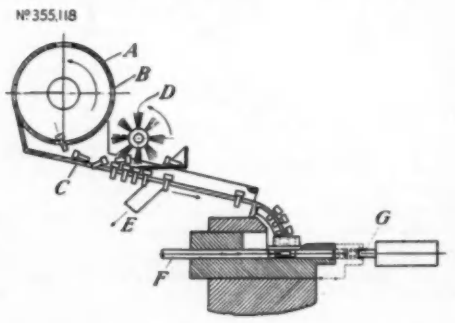

plug sockets to the carbon rods of dry cells. The caps are fed into a conical drum A, from which they escape through holes B. They fall into a trough C below and slide down, hanging by their heads with the socket protruding through a slot, as shown. If more caps are delivered than the machine can accommodate, they are brushed aside by the brush D, and returned to the inlet by the shoot E. The caps slide on down the trough into the ram F, which forces them on to the carbon rods, brought up one after another, at G.—*August 20th*, 1931.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF ELECTRICAL ENGINEERS.—Grosvenor House, Park-lane, W. Ball. 9 p.m. to 2 a.m.

INSTITUTION OF MINING ENGINEERS.—Manchester. Postponed summer general meeting.

TO-DAY AND SATURDAY, SEPTEMBER 26TH.

SHIPPING, ENGINEERING AND MACHINERY EXHIBITION.—Olympia, W. Daily, 11 a.m. to 9 p.m.

TO-DAY TO SUNDAY, SEPTEMBER 27TH.

INTERNATIONAL FOUNDRY EXHIBITION.—Milan.

TUESDAY TO FRIDAY, SEPTEMBER 29TH TO OCTOBER 2ND.

IRON AND STEEL INSTITUTE.—Autumn Meeting at Swansea. For programme see pages 105 and 255.

THURSDAY, OCTOBER 1ST.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Presidential address, "The Internal Combustion Engine and its Performances," by Mr. W. A. Tookey. 8 p.m.

FRIDAY, OCTOBER 2ND.

INSTITUTION OF CHEMICAL ENGINEERS.—Chemical Society's Rooms, Burlington House, Piccadilly, London, W. 1. Paper, "The Gas Generator as a Direct Producer of Metallurgical Products," by Messrs. N. E. Rambush and F. F. Rixon. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Lecture, "Reinforced Concrete in India," by Mr. R. P. Mears. 7.30 p.m.

SATURDAY, OCTOBER 3RD.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—College of Technology, Sackville-street, Manchester. Paper, "Low Total Carbon Cast Irons and their Service to the Foundryman," by Mr. W. West. 4 p.m.

WEDNESDAY, OCTOBER 7TH.

INSTITUTE OF FUEL.—Lecture Theatre of the Institution of Electrical Engineers, Victoria Embankment, London, W.C. 2. Joint meeting with the Diesel Engine Users' Association and other institutions. "Coal, Smokeless Fuel and Oil from the National Standpoint," by Dr. W. R. Ormandy. 7 p.m.

FRIDAY, OCTOBER 9TH.

CHEMICAL ENGINEERING GROUP.—Chemical Society's Rooms, Burlington House, Piccadilly, London, W. 1. Paper, "The Manufacture and Testing of Asphalt Paving Material," by Mr. D. M. Wilson. 8 p.m.

INSTITUTION OF PRODUCTION ENGINEERS.—Council Room of the Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Annual General Meeting. 7.30 p.m.

WEDNESDAY, OCTOBER 14TH.

NEWCOMEN SOCIETY.—Lecture Theatre of the Science Museum, South Kensington, London, S.W. 7. Presentation of short papers. 5.30 p.m.

THURSDAY, OCTOBER 15TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Annual Dinner.

FRIDAY, OCTOBER 16TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster. Special General Meeting. By-laws. 6 p.m.

OVERHEAD LINES ASSOCIATION.—At the Georgian Restaurant, Harrods, Ltd., Knightsbridge. Conversazione and Supper-dance. 8 p.m. to midnight.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE.—Royal Technical College, George-street, Glasgow. Presidential address by Mr. John Bird. 7.15 p.m.

WEDNESDAY, OCTOBER 21ST.

INSTITUTE OF FUEL.—At the Connaught Rooms, Great Queen-street, London, W.C. 2. Annual dinner and dance. 6.45 for 7.15 p.m.

L.C.C. SCHOOL OF ENGINEERING AND NAVIGATION.—The School of Engineering and Navigation at Poplar has been considerably enlarged since last session by the addition of a new wing. There is a new internal combustion engine laboratory, equipped, amongst other apparatus, with a 50 H.P. Diesel oil engine in addition to the steam engines laboratory, a new mechanics laboratory, a foundry, extended electrical laboratory, shops for electric and oxy-acetylene welding and additional class-rooms and drawing-offices. There has also been provided a students' reference library, together with a common room, a refectory and an assembly hall. The new building is now completed, and will be opened officially by H.R.H. Prince George on October 21st. The enrolment week for the evening session 1931–32 is September 21st–25th, and the building will be open for inspection on the evenings of September 24th and 25th, from 7 to 9 p.m.

A FLEXIBLE PIPE JOINT.—We have received a sample of a new form of joint for pipes, working under normal temperatures, which is being produced by Mr. John Inshaw, of Easterhouse, near Glasgow. For the purpose of making this joint the ends of two adjacent lengths of pipe are belled out at an angle of about 18 deg., either by driving a mandrel into the tube when it is hot or by using a specially shaped expander. The two tubes are then assembled with a "Unicone" joint between them. This joint is of hard rubber and fits into the conical ends of the tubes. Finally a split ring is put round the junction and is pulled up tight by two or more bolts according to the diameter of the pipe. It is obvious that such a joint permits a certain degree of flexibility, and we understand that the National Physical Laboratory has found that it will resist a pressure of 300 lb. per square inch when flexed through an angle of 6 deg. The joint is available in a large number of sizes ranging up to 6in. in diameter.

MANCHESTER COLLEGE OF TECHNOLOGY.—To keep abreast of the requirements of the times the part-time course in mechanical engineering at the Manchester College of Technology has undergone revision for the forthcoming term. The new syllabus provides a wide range of alternative subjects in the advanced course, so that it is now possible for a student to select as a special subject internal combustion engines, steam engines or steam turbines, automobile engineering, production engineering, central power station practice, electrical engineering and metallurgy. Another development at the College is the provision of a full-time two-year course in applied optics. This course has been designed to give, not only the necessary specialised knowledge directly pertaining to the optical profession, but also that broad general education which is equally desirable. Dr. K. G. Fenelon has been appointed Director of the Department of Industrial Administration. On October 3rd the dignity of honorary associateship will be conferred upon Lord Eustace Percy and Mr. Karl Baumann.

VOCATIONAL EDUCATION.—Speaking last Saturday in Oxford at the Conference of the British Institute of Adult Education, Sir Francis Goodenough said:—"Surely, the aim of all those interested in the welfare and happiness of those engaged in commerce and industry must be—without bothering their heads over distinctions between vocational and non-vocational—to encourage the provision for everyone, first, of as strong, broad, and lofty a foundation of 'sound general education' as is possible for that one; that is to say, up to the furthest point to which each one can through his aptitudes benefit by it; and to encourage the provision, after school age, of facilities and encouragement to carry forward the 'sound general,' cultural, education in parallel with or interwoven with, or, best of all, indistinguishable from, specifically vocational education and training. Because only in so far as the original roots continue to be watered, and only in so far as the vocational branches are grafted on or are made to grow out of those roots, can the individual develop to the full extent of his capacity alike as a productive unit, as a citizen, and as a human soul—only so can he become a master of much knowledge, yet able to think originally, widely, perhaps greatly, and feel deeply, soundly, worthily."